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田中先生近影（昭和29年8月19日撮影）

Dr. Shigeho TANAKA (photographed on August 19, 1954)

所　　感

田　中　茂　穂

この度、私の第77回誕生日を祝賀するため、多数の魚類関係の学者が論文集を作つて下さつたことは誠に感謝を表する辞もないほど嬉しく思います。東京大学理学部動物学教室に関係のある私の先生や先輩で魚、殊にその分類学を研究した学者の寿命を考えると、箕作（佳吉）先生が52才（数え年で計算、以下同様）、石川（千代松）先生が75才、宍戸（一郎）さんが68才、岸上（鎌吉）先生が63才、北原（多作）さんが53才で、中西（順夫郎）さんは理学部簡易科卒業であるが、60才前後の寿命であつたと思う。こう考えると、どうしたはずみか、私は今、77才である。考えて見ると、随分長い生涯とも、短い生涯とも考えられる。

日本の魚学者は今日では随分多くて、世界一を誇る米国の魚学者の数よりも遙に多く、この点に於ては世界に誇り得ることと思われ、斯学のため慶賀の至りである。

私は最早、老衰期で、自身に思う程の活動もできないが、ただ一つ心残りになるのは私が大学へ入学時代を主として、明治初期から大学を退職したまでの年月間に私に関係のある魚学を記録して大学に保存して置きたいと思うことであるが、果してこれが出来るかは私も保証ができない。

（昭和29年8月）

Notes on the Flying-fishes of Hachijo Island, with Nomenclatorial Remarks on the Flying-fishes of the Mainland of Japan and Hokkaido. II. *Cypselurus pinnatibarbatus japonicus*. (With Additional Notes on *Prognichthys agoo*) *Continued from p. 202*

Tokiharu ABE

(Tokai Regional Fisheries Research Laboratory, and Zool. Inst., Fac. Sci., Tokyo Univ.)

Visible portion of dorsal and anal fins. The relative height of the dorsal and anal fins changes greatly with advancing age, and the relative positions of the origins of these fins seem to vary to certain extent, although the anal origin is invariably behind the dorsal origin. Furthermore, the relative length of each fin-ray, especially that of the anteriormost fin-rays, varies considerably even in the adult. The change with age in the coloration of these fins is also very remarkable. It seems better to begin with the number of the fin-rays of the fins, which can easily be shown in table 3.

Table 3. Frequency distribution of the number of dorsal fin-rays (D) and that of anal fin-rays (A) in *Cypselurus pinnatibarbtus japonicus**

A \ D	12	13	14
9	1	1	1
10	7	14	1
11	7	20	4
12		1	1

The number of the anteriormost unbranched fin-rays in dorsal and anal fins is 1 or 2, oftener 1. Of the seven dorsal fins supported by 14 fin-rays, three have 2 unbranched fin-rays anteriorly; and of the two anal fins with 12 fin-rays, one has 2 unbranched fin-rays anteriorly. The 2nd, or the 3rd, and the subsequent fin-rays of the fins are branched, the last fin-ray usually being thick.

* Since this paper went to press, numerous specimens of *Cypselurus pinnatibarbatus japonicus* have been collected, of which the following have been examined in detail, and the results of the examination are incorporated hereafter:

Number of specimens	Total length (mm)	Fork length (mm)	Standard length (mm)	Sex	Maturity	Locality	Date of collecting, and remarks
1	410	343	322	♂	Testes fairly large	Manazuru	3～5/IV, '54. By a trap net
1	130		100			Off western coast of Hachijo I.	Night of 30～31/III, '54. Barbels reddish black. Bands of belly golden
1	132	112	105			〃	Night of 21～22/IV, '54. Barbelled
2	70,95	59,81	56.5, 75			〃	Night of 24～25/IV, '54. Barbelled

The relative height of the dorsal and anal fins, and more especially of the former, is remarkably great in the young of some 100 mm standard length. It may be of interest to compare the change with advancing age in the relative height of the dorsal fin in *Cypselurus pinnatibarbatus japonicus* with that of its close ally, *C. pinnatibarbatus californicus*, which was dealt with by HUBBS and KAMPA (1946). In the accompanying tables, the relative height of each fin-ray of the dorsal and anal fins in *japonicus* is first given (table 4), and the comparison of the highest dorsal fin-rays between the two forms just mentioned is made in table 5.

Table 4. Relative height of each fin-ray of dorsal (d) and anal (a) fins in *Cypselurus pinnatibarbatus japonicus*

Specimen	Standard length (mm)		Height / Standard length ×100 of 1st ray	2nd ray	3rd ray	4th ray	5th ray	6th ray	7th ray	8th ray	9th ray	10th ray	11th ray	12th ray	13th ray
Cat. No. 9797, ABE	100	d	18	21	26	28	29	28	26	25	22	20	14	10	6
		a	8	11	12	11	11	10	9	8	7	5			
Cat. No. 8746, ABE	320	d	10	13	13+	13+	13	12	10	8	7	6	5	4	5
		a	6	8	x	7	6	5	5	4	4	4	4		
Cat. No. 8741, ABE	324	d	9	11	12	11	10	9	8	7	x	6	4	5	
		a	3	7	7	6	6	5	5	4	4	4	4		

Table 5. Comparison of the relative height of the highest dorsal fin-ray between *Cypselurus pinnatibatus japonicus* and *C. p. californicus*. The data for the latter form have been cited from HUBBS and KAMPA, 1946, p. 203, table III.

japonicus			*californicus*		
Specimen from	Standard length (mm)	Height of highest dorsal ray / Standard length ×100	Specimen from	Standard length (mm)	Height of highest dorsal ray / Standard length ×100
Hachijo I.	56.5	25	near La Jolla	4.5	0.3
〃	75	25	off San Diego	69	24
Ō-murodashi	90	26	27°40′ N, 116°50′W	164	19
〃	94	27			
Hachijo I.	100	29			
〃	105	29	27°30′ N, 115° W	194	14
Izu-shichitō	157	24	〃	225	13
Hachijo I.	320	13	〃	228	14
〃	324	12	〃	242	12
			Catalina I. (Type)	300	11
			Southern California	305	10
			〃	308	11
			〃	309	10
			〃	310	13
			〃	311	11
			27° 30′ M, 115° W	328	10
			Southern California	330	10
			〃	345	9
			27° 30′ N, 115° W	349	10
			Southern California	350	10
			〃	326	9
			〃	378	10

As is seen from table 4, the relative height of the anal fin in *Cypselurus pinnatibarbatus japonicus* is greater in the young than in the adult, but the diminution with advancing age is not so marked as in the dorsal fin.

The relative positions of the dorsal and anal origins are shown in table 6.

Table 6. Relative positions of dorsal and anal origins in *Cypselurus pinnatibarbatus japonicus*

Standard length (mm)	Position of origin of anal fin: Below interspace between			
	3rd and 4th dorsal fin-rays	4th and 5th dorsal fin-rays	5th and 6th dorsal fin-rays	6th and 7th dorsal fin-rays
38.5		x		
56.5		x		
58	x			
64		x		
66			x	
74	x			
75		x		
87	x			
90		x		
94		x		
100			x	
105			x	
105			x	
157		x		
165	x			
305				x
310			x	
310			x	
310				x
318		x		
318				x
320			x	
320			x	
320				x
322				x
324		x		
327				x
332				x
333			x	
336			x	
336				x
336				x
338				x
342			x	
344			x	
344				x
346			x	
346				x
349			x	
352				x
352				x
354				x
355				x
360			x	
363			x	
364				x
366			x	
368				x
370			x	
375				x
380			x	

The dorsal and anal fins of the young are mostly blackish, only the outer margin of these fins and the proximal part of the anal being hyalne or whitish. In the adult, the anal fin is whitish, and the dorsal fin also loses the black color, only a black blotch remaining distally in the middlemost portion of the dorsal. This black blotch is however, sometimes not conspicuous.

Pectoral fin and pectoral girdle. The uppermost rudimertary fin-ray of the pectoral is very difficult to see without removing the skin and tendons covering it (fig. 8). Each half of this ray is proximally fused with each other while the distal end is separable from one another. The 2nd fin-ray from the top has hitherto been regarded as the uppermost unbranched fin-ray of the pectoral by predecessors and the present writer himself. It may be better for practical purpose to treat hereafter the uppermost rudimentary pectoral fin separately from the other pectoral fin-rays which are visible without removing the coverings at the proximal part of the fin. The writer tentatively denotes the uppermost rudimentary fin-ray by a itlicized small letter of the Roman numeral, *i*, and the next, unbranched, conspicuous fin-ray by a small letter of the Roman numeral, i. Thus the pectoral fin-formula is given as, *e. g.*, P. *i*+15 (i+14) (left); *i*+15 (i+14) (right), and so on. The 3rd fin-ray from the top (not excluding the uppermost rudimentary ray) and the lower fin-rays are all branched excepting for the lowermost one which is often unbranched. The frequency distribution of the number of the pectoral fin-rays is given in table 7. Whether the lowermost fin-ray is branched or unbranched, is not indicated in the table.

Table 7. Frequency distribution of the number of pectoral fin-rays (P) in *Cypselurus pinnatibarbatus japonicus*

P	left	*i*+14 (=i+13)	*i*+15 (=i+14)	*i*+14 (=i+13)	*i*+15 (=i+14)	*i*+16 (=i+15)
	right	*i*+14 (=i+13)	*i*+14 (i=+13)	*i*+15 (=i+14)	*i*+15 (=i+14)	*i*+15 (=i+14)
Number of specimens		13	5	2	29	1

The change with advancing age in the relative length of the pectoral fin is not so marked as in the dorsal fin. In table 8 is shown the relative length of each fin-ray of the left pectoral of a young and an adult examples.

Table 8. Relative length of each fin-ray (excepting for the uppermost rudimentary fin-ray) of the left pectoral in *Cypselurus pinnatibarbatus japonicus*

Specimen	Standard length (mm)	Length / Standard length ×100 of														
		1st ray	2nd ray	3rd ray	4th ray	5th ray	6th ray	7th ray	8th ray	9th ray	10th ray	11th ray	12th ray	13th ray	14th ray	15th ray
Cat. No. 9797, ABE	100	39	67	67	63	60	53	47	43	38	33	30	23	12	5	1
Cat. No. 8746, ABE	320	45*	66	72	68	63	56	48	42	38	34	30	25	15	7+	6

* The length of the uppermost rudimentary fin-ray is 15 mm, namely, 5 % of the standard length.

The coloration of the pectoral fin varies considerably even in the adult. The writer long wondered whether the adult taken in Sagami Bay by trap net in the daytime were different from those taken from Hachijo Island by gill-net in the night because of the difference in the coloration of the pectoral. When Dr. A. BRUUN visited Japan in December, 1953, the present writer talked to him about the point, and Dr. BRUUN kindly suggested that the pectoral fin of flying-fishes taken in the night might be darker in color than that of the same species taken in the daytime. Dr. BRUUN further suggested that the salinity of the sea might have some relation with the coloration of the pectoral fin of flying-fishes. On checking the relation between the catching method (gill-net operated in the daytime; trap net lifted early in the morning; trap net lifted at 3 or 4 p. m.; long-line operated in the daytime) and the coloration of the pectoral fin of *Cypselurus pinnatibabartus japonicus*, the writer has realized that with some exceptions, the suggestions by Dr. BRUUN hold true for this flying-fish. In fig. 2 is shown a right pectoral fin of an adult of *japonicus* taken in the night near Izu Shichitō (which include Hachijo Island) by gill-net. The fin, when folded and seen from outside, is light brownish violet, with a hyaline band along the posterior margin and with a hyaline area near the base. The ventral parts of the upper fin-rays are light. When expanded and seen from inside (or, from above), the fin is light brownish violet, the fin-rays (excepting for the lowermost ones) being darker than the membranes. The hyaline band along the posterior margin is fairly conspicuous. The light oblique area of the lower and proximal parts of the fin is not sharply bordered, and extends obliquely from the bottom to the membrane between the 6th and 7th (counted from top; excluding the uppermost rudimentary fin-ray) fin-rays. The hyaline band along the posterior margin of the fin is continuous with the light area just mentioned. In the majority of the examples of this form taken in the daytime near the coast of Sagami Bay, the pectoral fin is much lighter in color, the posterior hyaline hand and the light area below are apt to be overlooked. The specimen described in vol. iii, nos. 3/4/5, pp. 195, 196, was taken from open sea off Chikura in the daytime, and the coloration resembles those taken in the night near Hachijo.

The coloration of the pectoral fin changes considerably with advancing age. In the two non-barbelled young measuring 157 mm and 165 mm (fig. 3), respectively, in standard length, the pectoral fin is black posteriorly and dark brown proximally, leaving the intervening oblique and very narrow triangular area and the very narrow posterior margin white (suggestive of some other members of *Cypselurus* and *Hirundichthys speculiger*). The bottom of this light oblique area ventrally extends and is confluent with the light lowermost part of the fin. The fin-rays, and more especially the uppermost two (excepting for the rudimentary ray), are lighter than the membranes in the smaller specimen just mentioned.

In the barbelled young (figs. 4–6), the coloration of the pectoral fin is suggestive of the non-barbelled young mentioned above, but the black or brown area is mnch narrower; *e. g.*, in a specimen of 64 mm standard length (not figured), the pectoral

fin is mostly hyaline, with a few brown blotches near the posterior margin and near the center of the fin.

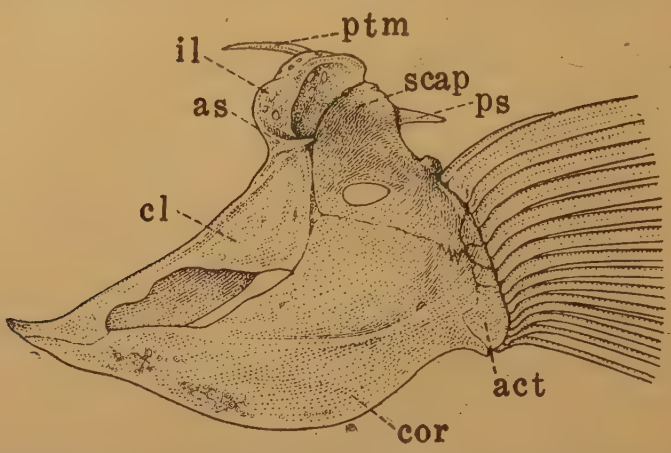

Fig. 8. Right pectoral girdle (exclusive of postcalvicle) and proximal part of pectoral fin of *Cypselurus pinnatibarbatus japonicus* taken near Hachijo I. in the night of March 7–8, 1953. Seen from inside. Total length of body 410 mm, standard length 322 mm. **act**: lowermost actinost. **as**: anterior spinule of clavicle. **cl**: clavicle. **cor**: coracoid. **il**: inner ledge of pocket of clavicle. **ps**: posterior spine of clavicle. **ptm**: posttemporal. **scap**: scapula. Drawn by M. Shirao and T. Abe.

So far, the present writer has examined the pectoral girdle of the genera *Oxyporhamphus*, *Exocoetus*, *Parexocoetus*, *Hirundichthys*, *Danichthys*, and the so-called *Cypselurus**, and has realized that there underlies a generealized "Cypselurus-type" of the girdle. Before describing the characteristics of the pectoral girdle in *Cypselurus pinnatibarbatus japonicus*, some general accounts of the "Cypselurus-type" of the pectoral girdle are thought necessary. Fortunately, Starks (1930, p. 45) gave some description of the primary pectoral girdle of *Cypselurus pinnatibarbatus californicus*, and the present writer wishes here to give additional accounts of the "Cypselurus-type" of the pectoral girdle.

In the so-called *Cypselurus*, the supratemporal is absent. The posttemporal is rather short, slightly expanded at its ventral end, and its postero-ventral part covers the dorsal side of the supraclavicle, which is much smaller than the posttemporal. The former bone is ventrally attathed to the outer side of the dorsal ridge below the perforated "pocket" of the strongly developed clavicle. This pocket has anteriorly an inner "ledge" of varying width. The latter is sometimes perforated, probably irrespective of species. On the inside (namely, nearer to the vertebral column) of the ventral end of this ledge is a spinule of varying sharpness. This spinule is directed backwards, and invariably much smaller than the spine at the postero-dorsal corner of clavicle. The writer wishes here to propose the name "anterior spinule of the clavicle" for the former and "posterior spine of the clavicle" for the latter. The latter is also directed backwards and continuous with the dorsal ridge of the clavicle. The keel on the

* The pectoral girdle of *Prognichthys agoo* resembles that of the so-called *Cypselurus*. In the absence of the skeleton of *Prognichthys gibbifrons*, the writer is not able to mention about the pectoral girdle of *Prognichthys*; the adoption of *Prognichthys* for *agoo* is only for convenience' sake.

outside of the coracoid is long and fairly high, while the ridge (or ridges) on the inside of the bone is (or are) very low. The actinosts, four in number, are fitted so tightly to the scapula and coracoid, and posteriorly forming so smooth a contour, that it is with some difficulty to recognize each actinost at a glance. The postclavicle seems to be composed of only one bone, which is flexible and somewhat twisted.

Now, in *Cypselurus pinnatibarbatus japonicus* the pectoral girdle is very rigid, and the "anterior spinule" and "posterior spine" of the clavicle are well developed. The inner ledge of the pocket of the clavicle is broader than in manny of the Japanese members of *Exocoetidae*. The keel on the outer side of the coracoid is also prominent, runs not parallel to the posterior margin of the outer wing of the clavicle, but downward and forward towards the postero-ventral margin of the outer wing of the clavicle, and terminates far from the latter. The inner ledge of the pocket of the clavicle is sometimes perforated.

Ventral fin and pelvic girdle. The number of the ventral fin-rays is 6, all the rays being branched and segmented. The coloration and relative length of the ventral fin changes with age. In table 9 is shown the relative length of each fin-ray of the ventral in a barbelled young and an adult examples. The barbelled young has much longer ventral fin than the adult does.

Table 9. Relative length of each fin-ray of the left ventral fin in *Cypselurus pinnatibarbatus japonicus*

Specimen	Standard length (mm)	$\frac{\text{Length}}{\text{Standard length}} \times 100$ of					
		1st ray	2nd ray	3rd ray	4th ray	5th ray	6th ray
Cat. No. 9797, Abe	100	16	41	43	38	34	30
Cat. No. 8746, Abe	320	10	27	29	27	24	22

In the adult the ventral fin is mostly hyaline; only the dorsal side of the outer 5 fin-rays are brownish and the membranes near these rays are dotted with minute brownish violet dots. The innermost fin-ray is almost colorless. In the young examples of 38.5–165 mm standard length, the ventral fin is brown or black, outer rays, posterior tips of the rays and proximal part being light (figs. 3–6). Occasionally a few light spots appear near the posterior corner of the fin.

The pelvic girdle of *Exocoetidae* offers good taxonomic criteria for higher groups. There is a generalized "Cypselurus-type" as in the case of the pectoral girdle. The pelvic girdle of the so-called *Cypselurus* is composed of a pair of separate pubics (fig. 9), whiche are free from the vertebral column and pectoral girdle. The pubic has a nearly vertical limb, which is compressed and sharply pointed dorsally, and a few basal horns which proximally connected with each other by a semitransparent thin bone,

* Counted from outside.

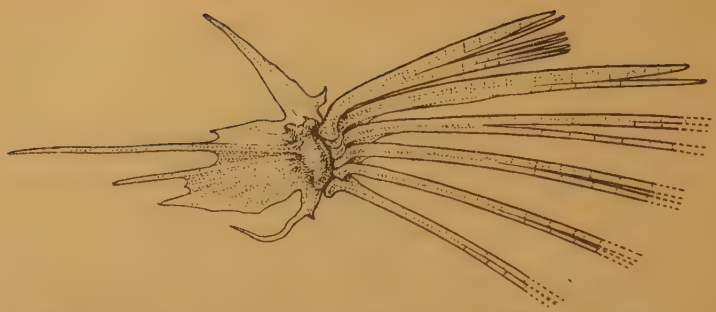

Fig. 9. Left half of pelvic girdle of *Cypselurus pinnatibarbatus japonicus* taken near Hachijo I. in the night of March 7–8, 1953. Seen obliquely from outside. Total length of body 410 mm, standard length 322 mm. Drawn by M. SHIRAO.

forming the "basal plate." The outermost horn of the basal plate is an attenuated rod, directed forwards, and connected by a semitransparent thin bone with the vertical horn of the pubic. The innermost horn of the basal plate of the pubic is curved, directing its tip outwards. The angle formed by the vertical horn and the basal plate is 90° or a little more, and the angle formed by the former and the outermost horn of the latter is 90° or a little less. It might be added here that the pelvic girdle of *Prognichthys agoo* belongs to the "Cypselurus-type". In *Cypselurus pinnatibarbatus japonicus* the number of the horns in the basal plate of the pelvic bone varies between 4 and 5. The outermost and innermost horn of the basal plate invariably retain the peculiar shape. The semitransparent thin bone connecting the vertical horn and the outermost horn of the basal plate is pointed anteriorly, and the postero-ventral corner of the vertical horn is flattened and has a few spines directed backwards and upwards.

The position of the ventral fin of *Cypselurus pinnatibarbatus japonicus* is farther backward than in the majority of the members of the so-called *Cypselurus*. In the adult the hind edge of the pubic is below the 24th vertebra (in 3 specimens), or 25th vertebra (in 5 specimens), or 26th vertebra (in 3 specimens). The preventral length in the adult is 58 % (in 2 specimens) and 60 % (in 2 specimens). The distance between the hind margin of the opercle and the ventral origin is not less than the distance between the latter and the base of the anteriormost ventral rudimentary fin-ray of the caudal as in *Cypselurus opisthopus hiraii*. In a barbelled young of 100 mm standard length, the preventral length is 58.5 % of the standard length, and the distance between the hind margin of the opercle and the ventral origin (38 mm) is slightly less than the distance between the latter and the base of the auteriormost rudimentary fin-ray of the caudal (40 mm).

Caudal fin. The powerfulness and the shape of the caudal fin seem to differ from species to species in certain cases, but as this fin is apt to be damaged by the catching or handling at the market it is not easy to state for certain about the specific difference in the relative length of the upper and lower lobes of the fin. Here the measurement of only an example of the adult is given. The skin and tendons at the base of the fin has been removed, and the root of each fin-ray has been exposed. The length of the longest (namely, the uppermost branched) fin-ray in the upper lobe is 22 % of the

standard length, 328 mm, and the length of the longest (namely, the unbranched fin-ray just below the lowermost branched) fin-ray is 32 % of the standard length. The posterior contour is deeply forked, and the lower lobe exceeds the upper greatly in length and strength.

The number of the fin-rays of the caudal in *Cypselurus pinnatibarbatus japonicus* is vi/6/7/viii (in 1 specimen); vi/6/7/ix (in 1 specimen); vii/6/7/viii (in 2 specimens); vi/6/8/viii (in 1 specimen); vii/6/7/ix (in 5 specimens); viii/6/7/ix (in 1 specimen). The number of the epeurals is mostly 3; only in 1 example it was 2.

The colorationof the caudal fin changes with age; whereas the barbelled young have two large black blotches on the lower lobe of the caudal fin, the caudal fin in the nonbarbelled young of some 160 mm standard length and the adult is uniformly dark, occasionally the central part of the hind margin being a little darker. The blackish vertical band at the caudal base, which appears in some of the young examples, is absent in the adult.

Scales. This flying-fish is externally easily recongnized by the higher number of the predorsal and preventral scales coupled with the backward position of the ventral fin and the large size attained by the adult. The number of the predorsal and preventral scales varies considerably from individual to individual as will be seen from tables 10 and 11. The predorsal scales are counted from the one just above the root of the posterior divergent horns of the supraoccipital backwards to the smaller one covering the base of the 1st dorsal fin-ray. In counting the preventral scales, the scale on, or in front of, the line connecting the ventral origins is regarded as the last preventral scale, and the anteriormost scale on the isthmus is regarded as the starting point of the counting.

Table 10. Frequency distribution of the number of the predorsal scales in *Cypselurus pinnatibarbatus japonicus*

Number of predorsal scales							
40	41	42	43	44	45	46	47
1	1	8	9	9	10	6	4

Table 11. Frequency distribution of the number of the preventral scales in *Cypselurus pinnatibarbatus japonicus*

Number of preventral scales						
29	30	31	32	33	34	35
1	2	4	4	5	6	4

The number of scales in an oblique row above the lateral line and passing the dorsal origin is mostly ½+7 or ½+8, and the number of scales in an oblique row below the lateral line and passing the anal origin is mostly 2+½ or 3+½.

The scales on the top of the head are sometimes modified in texture, bearing conspicuous irregular ridges. The writer has not been able to state for certain whether they are correlated with the maturity or not.

Branchiostegals. The left branchiostegal membrane ventrally broadly covers the right one, and the number of the branchiostegals of the left side tends to be greater than on the right side as will be seen from table 12.

Table 12. Frequency distribution of the number of the branchiostegals in *Cypselurus pinnatibarbatus japonicus*

	Number of branchiostegals						
Left	11	11	11	12	12	12	13
Right	9	10	11	9	10	11	11
	2	4	1	1	5	2	1

Gill-rakers. The gill-rakers on the first arch in the present form is rather less numerous than in the majority of the other Japanese commercial species of flying-fishes. The rakers on the upper limb (epibranchial) increase in length downwards, and those of the lower limb (ceratobranchial and hypobranchial) diminish in length downwards. The rakers below the joint of the upper and lower limbs are rather strong, not slender, and spaced fairly widely apart. The upper-most rakers of the upper limb and the lowermost rakers of the lower limb are sometimes rudimentary. The frequency dis tribution of the number of the gill-rakers on the first arch is given in table 13. Whereas the number of the branchiostegals on the left side tends to exceed that of the right side, the number of the gill-rakers on the first arch in the present form seems not to differ between the two sides in the same direction.

Table 13. Frequency distribution of the gill-rakers on the first arch in *Cypselurus pinnatibarbatus japonicus*

Left	6+14	7+14	6+15	6+14	6+15	7+15	7+15	7+15	7+15	7+15	7+16	7+16	7+16	7+16
Rtigh	6+15	7+14	6+15	7+15	6+16	6+15	6+16	7+15	7+16	6+17	6+16	6+17	8+16	7+17
	1	1	2	1	1	1	1	2	2	1	1	1	1	1

*Dentition.** In the present form teeth are present only on the jaws. The jaw teeth are long and usually conical; occasionally the tip is slightly expanded and provided

* As for the dentigerous pharyngeal bones, REGAN'S figure (1911) of *Exocoetus lineatus* well agrees with *japonicus*.

with one or two outer extra cups. The teeth are arranged in a narrow band anteriorly, and the latter tapers laterally and posteriorly, finally becoming a single row of the teeth. The number, shape and size of the teeth seem to vary considerably from individual to individual. In a few adult examples the length of the anterior teeth have been measured. The ratio of the length of these teeth to standard length was 0.0013–0.0022. In the barbelled young also the jaw teeth are long and very conspicuous.

Skull. The skull of the flying-fishes sometimes differ in shape from genus to genus, but there underlies a generalized "Flying-fish-type" of skull. *Oxyporhamphus* and *Parexocoetus* are considerably far apart from *Exocoetus*, *Cypselurus*, *Hirundichthys* and *Danichthys* in cranial features, the latter four genera having much in common in these features. But among the so-called *Cypselurus* are found considerable variation from species to species in regard to the skull. GREGORY's account (1933) of the skull of *Exocoetus volitans* LINNAEUS (given a *Halocypselus evolans*), and STARKS' account (1926) of the bones of the ethmoid region of *Parexocoetue brachypterus*, *Cypselurus bahiensis* and *C. pinnatibarbatus californicus* well apply to the "Flying-fish-type" of skull. The writer wishes here to give some supplementary notes. In the Japanese members of the so-called *Cypselurus*, the bony interorbital space is usually broad, flat or slightly concave, and the lateral margin of the cranium is incised just behind the sphenotic. The posteriorly projecting horns of the supraoccipital are well developed and usually bifid; occasionally there is an extra horn (fig. 10). The spine of the epiotic and that of the exoccipital is either present or absent depending on species. But the development of these spines is by no means symmetrical on both sides (fig. 10). In *japonicus* (fig. 10) the horns and spines just mentioned are all well developed; the roof of the cranium is never concave; the expanded pterotic slopes down from its joint with the frontal.

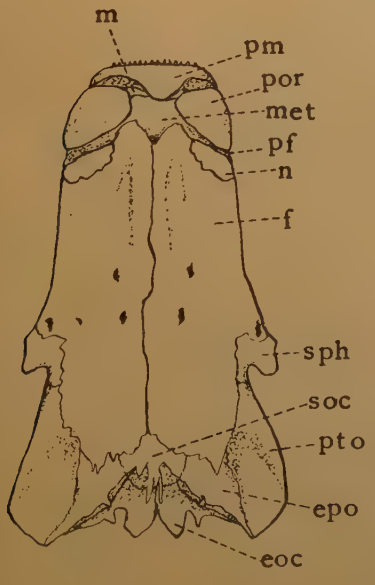

Fig 10. Dorsal view of skull of *Cypselurus pinnatibabatus japonicus* taken near Hachijo. I. in the night of March 7–8, 1953. Total length of body *ca.* 405 mm. **eoc**: exoccipital. **epo**: epiotic. **f**: frontal. **m**: maxillary. **met**: mesethmoid. **n**: nasal. **pf**: prefrontal. **pm**: premaxillary. **por**: preorbital. **pto**: pterotic. **soc**: supraoccipital. **sph**: sphenotic. Drawn by T. ABE.

Barbel, and bands on belly of the young. Probably correlated with the large size attained by the adult, the present form retains the juvenile characters (such as the co'oration of the fins and belly, presence of the large fimbricate barbel of the lower jaw, unusually great height of the dorsal fin) till a considerably late stage of development; the young of 132 mm total length have still the barbel, and the young of 200 mm total length have still very high dorsal fin and juvenile color pattern of the pectoral and ventral fins. Prior to preservation the barbel is reddish black, and the bands on the ventral side of the body, about nine in number, are golden and blackish. In earlier stages the barbel is fleshy (figs. 5a, 5b, 6), and later, at the total length of some 127 mm (figs. 4a, 4b, 4c), it becomes much thinner.

Remarks on taxonomic postion:

As FRANZ considered, the present form closely resembles *Cypselurus lineatus* (VALENCIENNES) of the Atlantic. The latter name, as HUBBS and KAMPA (1946) pointed out, is believed to be a synonym of *Cypselurus pinnatibarbatus pinnatibarbatus* (BENNETT). On the other hand, *japoniaus* is very close to *Cypselurus pinnatibarbatus californicus* (COOPER). In the absence of specimens of the close allies of *japonicus* from the Atlantic and the eastern Pacific, only the following might be stated here: *californicus* seems to spawn in August (after HUBBS and KAMPA, 1946, p. 191) while *japonicus* spawns during February-May near Hachijo I., where the surface tempertaure of the sea is then just rising from the minimum; the surface temperature near Hachijo at the beginning of the spawning is about 19°C. The diameter of the eggs seem to differ between the two forms whereas the number and distribution of the filaments of the eggs seem not to differ. The present writer wishes to turn to these points elsewhere.

Additional notes on *Prognichthys agoo*

In 1953 *Prognichthys agoo* was first shipped to the Central Wholesale Market of Tokyo from Nishizaki (Tateyama City, Chiba Pref.) on May 25. The number of the fish was very small, and the size was a little smaller than the adult predominating in number in summer. They were taken by a trap net. The adult of this species were taken in considerable quantity during July 10 ~ middle of September, 1953, near Izu-shichitō. In September, 1953, this species was shipped to Tokyo from the southern parts of Chiba Pref. During the summer of the same year, the writer saw several examples of some 200–250 mm total length which differed considerably in coloration from the adult (*vide* p. 199, explanation of fig. 7). Most striking was the presence of a black spot of the pectoral fin in some specimens. Unfortunately the figure has been reproduced very poorly. In some other specimens the black spots of the pectoral are more than 1 in number.

In 1954, a few adult examples of this species were first seen at the Central Wholesale Market of Tokyo on July 6. They were shipped from Izu-shichitō.

On September 5, 1954, this flying-fish was taken by a trap net off Tamanoura (Gotō Is.; west of Nagasaki), from which two adult examples were collected and sent to the writer by Mr. S. MITO (Kyushu Univ.). The writer wishes here to express his sincere thanks for Mr. MITO's kindness. Whereas this flying-fish is taken commercially along the Pacific coasts of the southern parts of the mainland of Japan, its occurrence near Nagasaki seems not to have been recorded since the original description by TEMMINCK and SCHLEGEL*.

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* Dr. M. BOESEMAN has kindly informed the writer (personal correspondence) that the material used by TEMMINCK and SCHLEGEL was collected at Nagasaki and vicinity.

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Ichthyological Notes

New, Rare or Uncommon Fishes from Japanese Waters. V. Notes on the Rare Fishes of the Suborders *Stromateoidei* and *Tetragonuroidei* (BERG). (*continued from p. 192.*)

By Tokiharu ABE

C. Records of Ariomma lurida from Sagami Bay. i) An adult male from Akazawa (north of Shimoda).* On April 12, 1952, an adult male, measuring *ca.* 430 mm in total length, of *Ariomma lurida* JORDAN *et* SNYDER was taken by a trap net off Akazawa, Tajima-mura, Shizuoka Prefecture. It was deposited at the Itō Branch Station of the Shizuoka Prefectural Fisheries Experiment Station, and later sent to the writer for study. This specimen is believed to be the second to be recorded from Japanese waters. The first record was given in 1952 by Prof. M. KATAYAMA. His specimen was collected at the market of Kōchi City on November 30, 1950. It measured *ca.* 183 mm in total length. As JORDAN (1923) and KATAYANA (1952) pointed out, *Ariomma* is a genus belonging to the family *Nomeidae.*

The specimen from off Akazawa measures 387 mm in fork length and 356 mm in standard length. The following measurements are given in hundredths of the standard length: Length of head 27.0, greatest depth of body 26.3, greatest breadth of body 17.7, least depth of caudal peduncle 5.5, diameter of eye** 6.5 (left) and 6.0 (right), interorbital (not bony) breadth (above centers of orbits) 10.3, length of snout 9.4, lentgh of highest (4th) dorsal spine 11.7, length of highest (2nd) soft fin-ray of dorsal 6.7, length of highest (2nd) anal spine 2.7†, length of longest pectoral fin-ray 13.6 (left) and 13.3 (right), length of ventral spine 6.5, length of longest (2nd on the left side; 1st on the right side) ventral soft-ray 10.7.

D. XI. I 15 (posterior soft-rays widely apart; last fin-ray thick); A. II 15; P. 24 on both sides (uppermost 2 rays unbranched; length of uppermost fin-rays increases down to 4th or 5th ray); V. I 5 (all fin-rays branched) on both sides. Ventral fins are received in a shallow groove, and the innermost fin-ray is connected with the belly by an extremely thin, semi-transparent membrane.

Pseudobranchiae well developed. Inner fold of left branchiostegal mambrane seems to cover its parther proximally. Branchiostegals *ca.* 6 on both sides. Gill-rakers 11+18 (left) and 9+1+19 (right). Tongue very wide, concave dorsally, and its anterior margin is nearly straight. It has numerous minute tubercles on the dorsal side. Inner side of opercle and proximal 2/3 of skinny ledge

(*continued on p. 246*)

* A new Japanese name, "Ōme-kon-nyaku-aji", is here proposed.

** The adipose eyelid is well developed, but covering the margin of the orbit only for a short distance. The measurement of the diameter of orbit was taken from the exposed part of the eye.

† The soft anal fin-rays have been damaged. The 3rd fin-ray seems to be the highest (excepting for the last fin-ray which is thick and long), which measures *ca.* 5.1 % of the standard length.

Ecological Analyses of Pelagic Shoals.

I. Analysis of Salmon Gill-net Association in the Aleutians.

1. Quantitative Analysis of Food

Hiroshi MAEDA

(Shimonoseki College of Fisheries)

There have hitherto been many investigations about salmons as to their ways of migration, age composition, problems of stocks, relations between the catches and oceanographical or meteorological conditions, statistics of catches in every year and fishing methods. But, here, I wish to try to analyse some data about salmons, which were collected during the period from May to August 1952 in the Aleutian waters where any comprehensive investigation have not yet been accomplished, from my own standpoint differing from those, mentioned above.

All the animals caught by the same gill-net must be considered to occupy the same layer at that time when they were caught, thus, they are closely related one another at least at that time, even if this relation means merely a momental coincidence of their daily rhythmic cycles. It seems to me very reasonable to call the animals caught by the same gill-net and those related with the animals precedent together a "gill-net association". From the synecological point of view, birds, parasites and planktonic animals among the members of gill-net association are put at present out of the considerations, because their life-forms differ from those of salmons; mammals, prey fishes, squids, *Theragra*, *Brama* and many other fishes are also excluded from the material of the present consideration, because some of them differ in their habitats, while others are situated in other orders in this association differing from that occupied by salmons. Thus, remain here five species of salmons, which occupy the similar habitat. Then, how are they segregated one another in habitat? What kinds of relations are observable between these salmons?

As the first step to answer those questions, I attempted a quantitative analysis of food of these salmons. The results tell us that these salmons take qualitatively the similar food, but the proportion of each component of food differes in species, and also that the mean value of the total food weight of each species change day to day moreover the total food weight of each individual in the same group* varies considerably and the amount of each food animal taken by each individual in the same group can be regarded to be independent from one another. The details of results, mentioned above, are described in the following chapters of this report.

Before going further, I must express my sincere thanks to Prof. K. TANAKA, Presi-

Contributions from the Shimonoseki College of Fisheries, No. 84

* *vide* p. 228

dent of our college, Prof. Dr. D. MIYADI (Kyôto University), Prof. Dr. I. MATSUI (our college), Dr. T. TOKIOKA (Kyôto University), and Dr. M. MORISITA (Kyūshū University) for their kind guidances and advices given to me. Also I must record here my hearty thanks to Mr. Y. SASAKI, Captain of the Shunkotsu-maru, the trainning vessel of our college, and fishery inspectors and commanders of fleets for their kindness in affording me many facilities for collecting the data and samples used in the present series of investigations.

THE SURVEYED AREA

The fishing was admitted in the area enclosed by thick line in Fig. 1. Our fleet reached the fishing ground (1) on May 11 and then cruised 45—100 miles south of Kiska

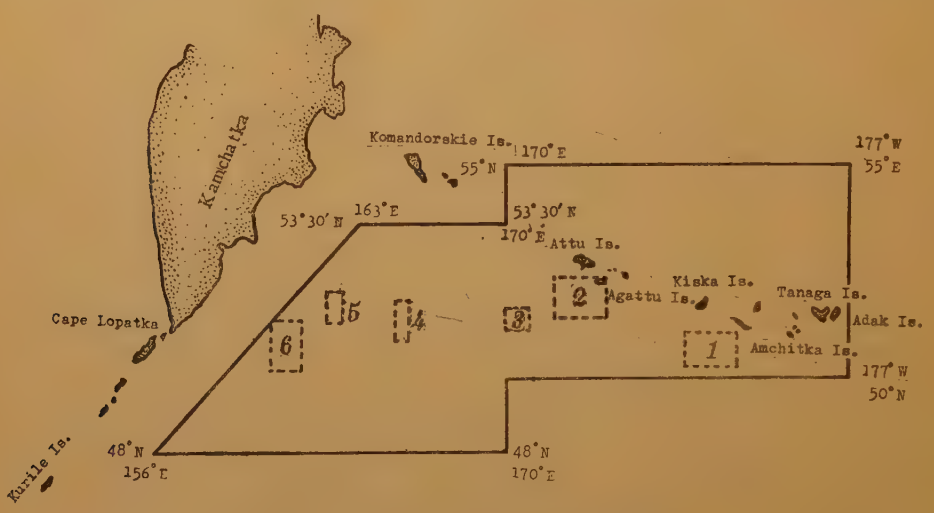

Fig. 1. Sketch map of fishing grounds

till June 10. The fleet then turned her course to west pursuing the migrating shoals, stayed in the fishing ground (2), 20–80 miles south of Attu, during the period from 15 to 26 of June, in the fishing ground (3), *ca.* 130 miles southeast of Attu, during the period from June 28 to July 2, in the fishing ground 4), 220–300 miles south of Beringa, from 5 to 10 of July, in the fishing ground (5), about 270 miles southwest of Beringa, from 12 to 16 of July, and lastly cruised 170–220 miles east of Cape Lopatka during the period from July 17 to the end of the fishing season.

MEMBERS OF THE GILL-NET ASSOCIATION

The animals caught in the gill net in this region are as follows:

Mammal: *Dolphinus* sp., *Phoca* sp. and some whales.

Birds: *Lunda cirrhata* (PALLAS) and *Larus schistisagus* STEJNEGER.

Fishes: *Oncorhynchus keta* (WALBAUM), *O. nerka* (WALBAUM), *O. gorbuscha* (WALBAUM), *O. kisutch* (WALBAUM), *O. tschawytscha* (WALBAUM), *Theragra chalcogramma*

(PALLAS), *Brama* sp. and some other fishes.

The stomach contents of salmons and *Therga* consist of the following animals:

Fishes: Myctophids, and fry of Cottids and some other fishes.

Arthropods:

Copepods ·····*Calanus cristatus* and *C. plumchurus.*

Euphausids ·····*Thysanoessa* sp. and *Euphausia pacifica.*

Gammalid amphipods·····*Parathemisto* sp.

Molluscs: Squids and *Limacina helicina.*

Parasites found in the alimentary canals of salmons and *Therga* are some Cestods and Nematods.

The fishing ground (1) was occupied chiefly by *Oncoryhnchus keta* and *O. nerka*, in the grounp (2) *O. gorbuscha* became to increase besides the two preceding species in abundance, in the ground (3) *O. kisutch* and *O. tschawytscha* began to appear and the ground (4) to (6) were occupied chiefly by *O. gorbuscha.*

MATERIALS USED, METHODS AND RESULTS

The caught fishes were brought to the mother-ship from 9 to 12 a. m. every day. The samples for the study of stomach contents were collected on the mother-ship before the salting. The total length measured, the body weighed, and then the viscera were

Table 1. Stomach contents of *O. keta*

Date	Size of sample		Fishes	Molluscs	Arthropods				Mucus	Total	
					Copepods	Gamalids Amphipods	Euphausids	Fr. etc.			Except mucus
VI-28	38	Σx	0.1		16.9	3.8	9.2	0.1	143.1	173.2	30.1
		Freq.	1		14	10	5	1	31	32	21
		S^2			2.8841	0.1108	1.4551				5.3066
VI-29	5	Σx	29.8	0.7	2.7	0.2	11.9	0.2	7.5	53.0	45.5
		Freq.	1	2	2	2	3	1	2	5	5
		S^2	142.0864	0.0384	1.0460	0.0024	19.4816				165.365
VII-2	24	Σx	0.1	5.0	21.0	3.3	13.7	0.2	20.4	63.7	43.3
		Freq.	1	5	12	6	8	2	16	24	19
		S^2		0.1956	3.2752	0.0990	2.0455				4.6396
VII-7	22	Σx		1.0	2.0	3.1	2.1		146.4	154.6	8.2
		Freq.		2	9	9	3		22	22	15
		S^2		0.0207	0.0299	0.0633	0.0823				0.3135
VII-20	25	Σx				27.1	36.1		39.4	102.6	63.2
		Freq.				16	7		16	24	19
		S^2				2.9430	17.8889				23.0851
VII-21	28	Σx	27.1	0.3	6.3	15.3	4.1		4.3	57.4	53.1
		Freq.	2	1	5	15	5		3	23	21
		S^2	25.0993	0.0031	0.8448	0.7325	0.2554				2.572
Total	142	Σx	57.1	7.0	48.9	52.8	77.1	0.5	361.1	604.0	243.4
		Freq.	5	10	42	58	31	4	90	130	100
		$\Sigma x/142$	0.402	0.049	0.344	0.372	0.543	0.004	2.543	4.254	1.714

Table 2. Stomach contents of *O. nerka*

Date	Size of sample		Fishes	Molluscs	Arthropods				Mucus	Total	
					Copepods	Gamalids Amphipods	Euphausids	Fr. etc.			Except mucus
VI-29	6	Σx		1.5	0.1	0.2	31.0			32.8	32.8
		Freq.		1	1	1	6			6	6
		S^2		0.3125	0.0014	0.0056	14.4122				15.7827
VII-2	36	Σx	12.5	40.0	48.8	0.9		0.5	25.1	127.8	102.7
		Freq.	3	5	17	3		1	25	36	23
		S^2	0.6278	15.0093	5.0142	0.0136					19.342
VII-7	5	Σx		0.5	0.2	0.2	25.9		2.9	29.8	26.8
		Freq.		1	2	2	3		3	5	4
		S^2		0.0400	0.0024	0.0024	84.5936				103.352
VII-10	18	Σx			4.9	4.2	0.1		13.2	22.4	9.2
		Freq.			6	8	1		16	18	10
		S^2			0.4087	0.4645	0.0005				1.52457
VII-20	19	Σx	6.0	0.5	1.5	8.3	72.8	1.4	2.4	92.9	90.5
		Freq.	1	1	1	4	12	1	1	17	17
		S^2	1.7950	0.0125	0.1122	1.0244	25.8401				26.0380
VII-21	18	Σx		0.2	10.1	16.5	54.1	1.7	2.0	84.8	82.6
		Freq.		2	5	10	9	3	1	16	16
		S^2		0.0010	1.2346	2.8436	35.1217				34.9184
Total	102	Σx	15.4	42.7	65.6	30.3	183.9	5.6	45.6	390.3	344.7
		Freq.	4	10	32	28	31	5	46	98	76
		$\Sigma x/102$	0.151	0.419	0.643	0.297	1.803	0.055	0.447	3.826	3.379

Table 3. Stomach contents of *O. gorbuscha*

Date	Size of sample		Fishes	Molluscs	Arthropods				Mucus	Total	
					Copepods	Gamalids Amphipods	Euphausids	Fr. etc.			(Except mucus)
VI-28	26	Σx	11.5	19.3	7.7	15.2	12.3	1.4	14.3	81.7	67.4
		Freq.	4	3	8	13	5	2	17	25	20
		S^2	2.0448	7.3371	0.5219	0.8790	4.6158				12.0167
VI-29	7	Σx	77	1.0	7.0		110.5	0.5	3.0	129.7	126.7
		Freq.	3	1	1		7	1	1	7	7
		S^2	4.9743	0.1225	6.0000		123.28				99.42
VII-2	2	Σx		19.5					1.0	20.5	19.5
		Freq.		1					1	2	1
		S^2									
VII-7	22	Σx	4.2	6.8	1.8	40.8	74.5	15.0	17.2	160.3	143.1
		Freq.	5	6	3	17	9	5	10	21	19
		S^2	0.1317	0.6190	0.0615	6.2361	23.3921				29.6338
VII-20	17	Σx	2.5	4.7		19.5	96.8	3.5	7.2	134.3	127.1
		Freq.	1	2		9	13	1	3	17	16
		S^2	0.3460	0.9759		4.0543	19.2382				14.0457
VII-21	23	Σx	57.4	0.5		24.7	331.0	7.6	1.5	422.7	421.2
		Freq.	11	1		18	19	4	1	23	23
		S^2	23.0839	0.0104		3.3011	166.3008				171.1821
Total	97	Σx	83.3	50.8	16.5	100.2	625.1	28.0	44.2	949.2	905.0
		Freq.	24	14	12	57	53	13	33	95	86
		$\Sigma x/97$	0.859	0.524	0.170	1.033	6.444	0.289	0.456	9.786	9.330

Table 4. Stomach contents of *O. kisutch*

Date	Size of sample		Fishes	Molluscs	Arthropods				Mucus	Total	
					Copepods	Gamalids Amphipods	Euphausids	Fr. etc.			Except mucus
VII-2	4	Σx		31.0			23.7		1.1	53.6	54.7
		Freq.		1			2		1	4	3
		S^2		180.1875			40.7169				
VII-7	15	Σx	17.1	4.2	8.7	0.5	3.5	1.5	12.6	48.1	35.5
		Freq.	7	3	5	2	1	1	8	15	14
		S^2	6.4277	0.3309	0.8896	0.0102	0.7622				6.3738
VII-10	10	Σx	4.0	3.0	2.7		11.7		13.7	35.1	21.4
		Freq.	1	1	1		1		9	10	2
		S^2									20.576
VII-18	14	Σx	13.0		5.4		21.7	1.0	30.7	71.8	41.1
		Freq.	1		2		3	1	13	14	4
		S^2	11.1535		1.3055		14.2968				52.7763
VII-20	20	Σx	8.7	7.2			9.7		5.6	31.2	25.6
		Freq.	2	1			3		8	14	6
		S^2									4.7396
Total	63	Σx	42.8	45.4	16.8	0.5	70.3	2.5	63.7	239.8	178.3
		Freq.	11	6	8	2	10	2	39	57	29
		$\Sigma x/63$	0.679	0.721	0.267	0.008	1.116	0.040	1.011	3.806	2.830

Table 5. Stomach contents of *O. tschawytscha*

Date	Size of sample		Fishes	Molluscs	Arthropods				Mucus	Total	
					Copepods	Gamalids Amphipods	Euphausids	Fr. etc.			Except mucus
VII-2	2	Σx							1.3	1.3	0
		Freq.							2	2	0
		S^2									
VII-7	4	Σx		1.4					1.0	2.4	1.4
		Freq.		1					1	2	1
		S^2									
VII-10	24	Σx		22.0					23.0	45.0	22.0
		Freq.		3					18	20	3
		S^2									6.7971
VII-18	3	Σx							3.5	3.5	0
		Freq.							2	2	0
		S^2									
VII-20	10	Σx					3.9		8.5	12.3	3.9
		Freq.					1		8	9	1
		S^2									1.5210
VII-21	3	Σx		1.0						1.0	1.0
		Freq.		1						1	1
		S^2									
Total	46	Σx		24.4			3.9		37.2	65.5	28.3
		Freq.		5			1		31	36	6
		$\Sigma x/46$		0.530			0.085		0.809	1.424	0.615

Each value is represented by gramme.

Fr. etc. : Fragments and others.

Σx : Total of respective value in respective group.

Frep. : Frequency.

S^2 : Deviation of respective value in respective group.

taken out and preserved in formalin. The stomach contents were examined in the Laboratory of our college and classified into the components as shown in tables 1-5; the wet weight of each food component in each individual was measured (Tables 1-5).

DISCUSSION AND CONCLUSION

1. Qualitative analysis of food.

If some fishes differ from one another qualitatively in their foods, they can be considered to belong respectively to different orders in an association. If their foods are qualitatively similar one another, but differ in proportions of components, they can be ranked in a certain order. If their foods resemble one another qualitatively and also in proportions of components, but differ quantitatively, they can be considered to be segregated in daily rhythm to take food or differentiated in amount of food they require.

In the present case, the foods of the five species of salmons are qualitatively similar one another and consist chiefly of smaller fishes, squids, and large planktonic crustaceans such as euphausids, gammalid amphipods and some copepods. These contents of foods seem to grant these salmons the order in the gill-net association, similar to the niche occupied by mackerel in the community in the temperate region.

2. Considerations on the proportions of food components.

On the basis of the proportion of each food animal shown in tables 1-5, I have tried to settle the ranks of these five species of salmons. Food animals are classified into the following 3 groups according to their body sizes: 1) large-sized food animals like fishes and squids, 2) medium-sized food animals like euphausids and 3) smaller-sized ones like gammalid amphipods and copepods. Then the rank of each salmon was determined on the following two standards:

1. The fishes with higher proportion of larger food animals in stomach contents are situated in higher ranks.
2. The fishes with higher proportion of smaller food animals are situated in lower ranks.

Thus the ranks of these salmons are determined as follows: *O. tschawytscha*—*O. kisutch*—*O. nerka*, *O. keta* and *O. gorbuscha*, arranged in the order from higher to lower; this order coincide with that of body weights of these salmons. Next, from the distribution of proportions of these three food groups, salmons in the Aleutian waters are classified into the following three types: 1) *O. tschawytscha*—*O. kisutch* type in which the size of the food animals are the larger, the proportions of them are the higher, 2) *O. keta* type in which the proportion of each food group roughly invariable, although that of large-sized food animals decrease slightly with the amount of food and 3) *O. nerka*—*O. gorbuscha* type in which medium-sized food animals occupy the largest part of the stomach content.

3. Discussion upon the total food weight.

The term "group" is used here conveniently to indicate all fishes of the same species caught in the same day. The mean value of the total food weight of each species

changes day to day, moreover the total food weight of each individual in the same group is not similar but varies considerably. On account of these facts, I can hardly discuss on the inter-specific differences of the mean values of the total food weight of the five species of salmons, although they are, at first appearance, arranged as follows; *O. gorbuscha O. nerka O. kisutch O. keta O. tschawytscha*, which coincides with the reversed order of body weight or food rank.

4. Considerations upon the correlation coefficient between the amount of each food animal taken by each individual in the same group.

In order to examine whether the fishes which take a large amount of a certain sort of food animals take also a larger quantity of other food animals or take a less amount of them than those which take a less amount of that sort of food, I estimated the correlation coefficient between the amounts of food animals, which are shown in table 6.

Table 6. Correlation coefficient between the amount of each food animals

Species	Date	Size of sample	r								
			C - G	C - E	E - G	A - M	A - P	P - M	L-Ms	L-S	Ms-S
O. nerka	VI-29	6	+0.991****	−0.149	−0.149	−0.345	—	—	−0.338	−0.200	−0.147
	VII-2	36	−0.130	—	−0.451	−0.00019	−0.175	−0.845****	—	−0.103	—
	7	5	+1.00****	−0.451	−0.048	−0.265	—	—	−0.271	0.612	−0.451
	10	18	+0.654***	−0.065	−0.000	—	—	—	—	—	−0.060
	20	19	−0.102	−0.178	−0.000	−0.080	−0.205	—	−0.187	−0.105	−0.055
	21	18	−0.244	−0.156	−0.103	−0.0945	—	—	0.129	0.104	−0.217
O. keta	VI-28	38	+0.866****	−0.511***	−0.059	—	—	—	−0.033	−0.036	−0.056
	29	5	−0.388	−0.279	−0,422	−0.429	−0.274	+0.153	−0.218	−0.291	−0.307
	VI-2	24	−0.062	−0.048	−0.164	−0.121	—	—	−0.178	−0.003	−0.162
	7	22	−0.221	−0.166	+0,790***	−0.285	—	—	−0.050	0.370	0.625****
	20	25	—	—	0.098	—	—	—	—	—	0.098
	21	28	−0.107	−0.072	−0.146	−0.082	−0.146	−0.037	−0.057	−0.126	−0.160
O. gorbuscha	VI-28	26	+0.085	−0.089	−0.0976	−0.117	+0.039	−0.085	−0.087	−0.094	−0.125
	29	7	—	−0.397	—	−0.542	−0.527	−0.018	−0.459	−0.046	−0.397
	VII-7	22	+0.592***	−0.059	−0.144	+0.198	−0.0384	−0.0207	0.124	0.052	−0.141
	20	17	—	—	−0.395	−0.353	+0.961****	−0.070	−0.157	−0.110	−0.395
	21	23	—	—	−0.275	−0.137	−0.080	−0.0224	−0.080	0.280	−0.275
O. kisutch	VII-2	4	—	—	—	−0.536	—	—	−0.536	—	—
	7	15	−0.203	−0.164	−0.088	+0.028	−0.271	−0.188	−0.045	−0.228	−0.177
	10	10	—	—	—	+0.103	+0.103	+1****	−0.111	1****	−0.111
	18	14	—	−0.130	—	—	+0.809****	—	0.818****	0.094	−0.130
	20	20	—	—	—	−0.093	−0.136	−0.076	−0.165	—	—

r	: Correlation coefficient	Significance level	
C	: Copepods	*	: 0.05
G	: Gammalid amphipods	**	: 0.02
E	: Euphausids	***	: 0.01
A	: Arthropods total	****	: 0.001
M	: Molluscs		
P	: Fishes		
L	: Large-sized food animals		
Ms	: Medium-sized food animals		
S	: Small-sized food animals		

The values which can be regarded as ± 1 under 0.05 level of significance are marked in the table. Most values are small negative ones. For this reason, it may be allowed safely that the amounts of different food animals taken by individuals in the same group are considered in most cases not correlated positively or negatively but rather independent one another.

SUMMARY

1. The term "gill-net association" is proposed for the animals caught by the same gill-net at the same time and animals related closely with them. And members of the gill-net association in the Aleutian waters during the period from May to August 1952 are shown in this report.

2. The stomach contents of five species of salmons (*Oncorhynchus tschawytscha*, *O. kisutch*, *O. keta*, *O. nerka* and *O. gorbuscha*) are examined and classified into fishes, molluscs, copepods, gammalid amphipods and euphausids, each weighed in the wet weight for every individual.

3. These salmons take food qualitatively similar one another and occupy the bio-economical situation in the association, corresponding to that of mackerels in the communities in the temperate region.

4. The food animals are classified into the 3 groups according to their sizes: 1) larger-sized group like squids and prey fishes, 2) medium-sized group like euphausids and 3) smaller-sized group like gammalid amphipods and copepods.

5. These salmons are classified into following three types according to the distribution of proportions of each group of food animals taken by each species: 1) *O. tschawytscha* –*O. kisutch* type, 2) *O. keta* type and 3) *O. gorbuscha* –O. *nerka* type.

6. The mean value of the total food weight of each species changes day to day. The total food weight of each individual in the same group is not similar but varies considerably.

7. The correlation coefficients between the amount of each group of food animal taken by each individual in the same group are shown in table 6; the values which can be regarded as $\pm$ 1 under 0.05 level of significance are marked with the asterisk, although the amounts of food animals are considered in the most cases to be independent one another.

References

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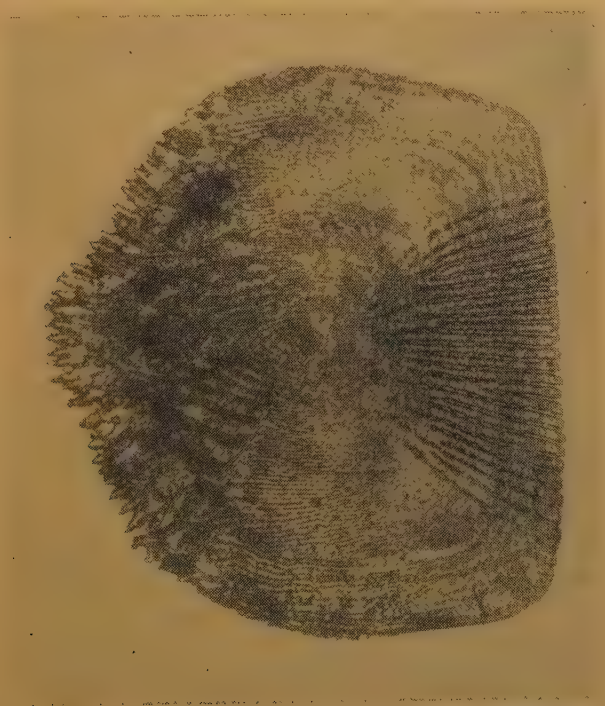
雑　　錄

カムルチーの鱗

カムルチー *Channa argus* (Cantor) の鱗は円鱗とみなされている。例えば岡田・松原の日本産魚類検索の p. 143 (1938) によつても、カムルチー科 Ophicephalidae の魚は「すべて円鱗」と明記してあり、又 Matsui, I. は Jour. Shimonoseki Coll. Fish., vol. 1, No. 1, p. 44 (1949) において、満洲産の本種の 12.5 cm の小形魚から 80 cm に産する大形魚まで検べているにかかわらず、円鱗か櫛鱗か？については一語も記載されていない。

筆者は 41 cm の体側鱗を検したところ、この鱗の後縁に、ちようどサバ属 *Scomber*の鱗に見られるような（小林、魚雑、第一巻、 p. 180, Fig , 150）顕著な突起のあることを見出した。櫛鱗は発生学的にはすべて円鱗から出発するのであるが、こんなに後れて突起の発生を見ることは珍らしいことである。



体長 41 cm のカムルチー *Channa argus* (Cantor) の鱗（体側中央部よりとる）。

（小 林 久 雄）

サケ科魚類の口腔にある分類形質に就いて

Ⅱ 太平洋産サケ科魚類

野　村　　稔

（東京水産大学）

On the taxonomic characters in the mouth cavity of salmonoid fishes

II. Pacific salmons

Minoru Nomura

(Tokyo University of Fisheries)

緒　　言

サケ科魚類は鋤骨部と口蓋骨部の両隆起の口腔上壁における相互の配置、及びそれら隆起や口蓋膜の形態などにより分類することができることを、主として淡水産の鮭鱒類について述べ、その結果を報告した。

今回は、その後得られたマス（*Oncorhynchus masou*）、ベニマス（*O. nerka*）マスノスケ（*O. tschawytscha*）と、前回のサケ（*O. keta*）、カラフトマス（*O. gorbuscha*）を比較検討して、5 種の太平洋産鮭鱒類について、口腔にある分類形質を調べた結果、太平洋産サケ科魚類においても、この分類形質は種の同定に役立つことを知つたので、ここに報告する。

本論を草するに際し、終始指導助言を賜り実験材料蒐集の労を賜つた東京水産大学稲葉伝三郎教授、実験材料を提供して下さつた日魯漁業の雨宮栄蔵、栃木県水産指導所斎藤弁、及び東京水産大学高木和徳の各氏、並びに文献を紹介下さつた淡水区水産研究所長黒沼勝造博士に、謹んで感謝の意を表する。

材料及び実験方法

材料は主に 1953 年 7 月から 12 月の間に捕獲されたもので、産卵のため遡河してきたもの、及び北太平洋産のものである。

これら材料は魚体測定後、頭部を上顎、下顎及び鰓の 3 部分に分離し、鰓耙数を数えた後、下記につき夫々観察した。

i　鋤骨部隆起と口蓋骨部隆起先端との間隔及び両者間の突出度合。

ii　鋤骨部隆起の形態；隆起先端と後端の鼻孔及び眼窩に対する位置、隆起の高さと巾、歯の並び方とその形態。

iii　口蓋骨部隆起の形態；隆起先端と後端の鼻孔及び眼窩に対する位置、隆起の高さと巾、隆起の彎曲の様子、歯の並び方とその形態。

iv　口蓋膜の巾及びその長さ

材料の魚体測定値、採取年月日及び採捕場所などは Table 1 に示してある。

Table 1. Size, gill-raker, sex, date and locality of the material

Scientific Name (Jap. Name)	Body Length	Head Length	Body Weight	Gill-rakers	Sex	Date	Locality
	(cm)	(cm)	(kg)				
Oncorhynchus masou (Masu)	53.5	12.0	1.70	L. 8+11 R. 8+11	♀	X, '53	Naka River
	46.6	9.9	1.02	L. 8+11 R. 8+11	♂	XI, 6, '53	
O. nerka (Benimasu)	55.0	12.0	1.51	L. 15+23 R. 13+23	♀	VII, 5, '53	Bering Sea
	43.0	9.5	1.40	L. 14+22 R. 13+24	♀	'53	
	50.0	12.7	2.30	13+20	♂	—	—
O. tschawytscha (Masunosuke)	56.0	12.1	2.65	L. 9+12 R. 9+12	♀	'53	Bering Sea
	—	20.0	—	L. 9+13 R. 10+13	♀	VII '53	
	73.0	17.9	6.50	8+13	♀	—	—
O. keta (Sake)	—	16.0	—	9+15	♂	XII, '51	Shinano River
	—	10.9	—	L. 8+14 R. 8+13	♀		Naka River
	—	13.0	—	9+14	♂		
O. gorbuscha (Karafutomasu)	50.0	12.5	2.40	L. 11+18 R. 11+18	♂	VII, 5, '53	Bering Sea
	49.0	12.5	2.08	L. 12+19 R. 12+20	♂		

記　　載

マス *Oncorhynchus masou* (Brevoort)

Fig. 1. A, a.

鋤骨部隆起と口蓋骨部隆起先端との間隔は前者の最大巾と略同長であり、前者の先端部は後者前部より前に突出している。

鋤骨部隆起の形態：　隆起先端は鼻孔より突出し、後端は眼窩の前縁より眼窩径の約¼のところまで達している。隆起は高くないが巾が広く眼窩径の½—¾である。歯の多くは脱落しているが、先端は1対づゝ2列に、後端は交互に2列に生えている。鋤骨部隆起の中央に1条の溝があつて、それに続く口腔上壁中軸部には皺が少く平滑である。

口蓋骨部隆起の形態：　隆起先端は略鼻孔と同位置か或はそれより僅か後方より始り、後端は眼窩の中央位置まで達している。隆起は高く且つ巾も広く、僅か外側に向つて彎曲している。歯は1列に並び雌雄共に強大であり、大さは後方になるにつれて漸次小さくなつている。

口蓋膜は巾狭く眼窩中央より僅か後方までである。

舌は比較的長く、舌の中軸部はくぼみ、その両側に平行した隆起があつて、その上に歯が約4個づつ生えている。

ベニマス *Oncorhynchus nerka* (Walbaum)

Fig. 1. B, b.

鋤骨部隆起と口蓋骨部隆起先端との間隔は前者最大巾の 1.5～2.5 倍あり、前者の先端部は後者の前部より前に突出している。

鋤骨部隆起の形態： 隆起先端は鼻孔より僅か突出し、後端は眼窩の前縁より僅か後方まで達している。隆起は低く、その巾は眼窩径の 1/5—1/6 である。歯は弱小であり、その大さは不整で不規則に生えている。鋤骨部隆起の左右両側には各々2～3条の皺があり、それに続く口腔上壁中軸部には多数の皺が巾広くある。

口蓋骨部隆起の形態： 隆起先端は鼻孔と同位置か或はそれより僅か後方より始まり、後端は眼窩前縁より眼窩径の 1/4 のところまで達している。隆起は低く、歯は弱小であり、その大さは不整で不規則に 1 列に並んでいる。隆起は湾曲せず殆んど直線である。

口蓋膜は鋤骨部隆起先端には接してないが口蓋骨部隆起先端に僅か接しており、眼窩の中央位置より僅か前までである。

舌は比較的長く、歯は V 字型に並んでおり、歯の先端が斜め後方外側に向つて生えている。

マスノスケ *Oncorhynchus tschawytscha* (Walbaum)

Fig. 1. C, c.

鋤骨部隆起と口蓋骨部隆起先端との間隔は前者の最大巾の 3.5～4.5 倍であり、前者の先端部は後者の前部より僅か前に突出している。

鋤骨部隆起の状態： 隆起先端は鼻孔位置より始まり、後端は眼窩前縁か或はそれより僅か後方まで達している。隆起は先端のみ僅かあり、その巾は狭く眼窩径の約 1/7 である。歯は隆起の先端のみに生えており他は脱落していたが表皮上の痕跡より 1 対づつ 2 列に約10個並んでいたことが認められた。歯は弱小である。口腔上壁には皺はなく平滑である。

口蓋骨部隆起の形態： 隆起先端は鼻孔より僅か後方より始まり、後端は眼窩中央位置まで達する。隆起は長いが低く且巾も狭く、僅か外側に向つて彎曲している。歯は弱小で、歯の先端が後方に向つて生えており規則的に 1 列に並んでいる。

口蓋膜は巾が狭く、眼窩の中央位置までである。

舌は比較的長く且扁平であり、歯は左右両側に平行に並んで生えている。

サケ *Oncorhynchus keta* (Walbaum)

Fig. 1. D, d.

Tchernavin, V. の記載を読んだ結果、前報記載に於いて不足な点を補足した。

鋤骨部隆起と口蓋骨部隆起先端との間隔は前者の最大巾の 3.5～4.5 倍あり、前者の先端部は後者の前部より前に突出している。

鋤骨部隆起の形態： 隆起先端は鼻孔位置より始まり、後端は眼窩の前縁まで達している。隆起は殆んどなく、その巾も極めて狭く眼窩径の約 1/8 である。歯は比較的強大で、1 列に約 4 個並んでいる。鋤骨部隆起に続く口腔上壁中軸部には細い皺が断続的に巾広く拡がつている。

口蓋骨部隆起の形態： 隆起先端は鼻孔より後方において始まり、後端は眼窩中央位置より僅か前方まで達する。隆起は比較的高いが巾は狭く、殆んど直線状で湾曲していない。歯は強固で歯の先端が内側に向つて生えている。

口蓋膜の巾は比較的広く、鋤骨部及び口蓋骨部両隆起の先端を覆つて眼窩中央位置まで達している。

舌は細長く歯は V 字型に約 4 個づつ並んでいる。

カラフトマス *Oncorhynchus gorbuscha* (WALBAUM)

Fig. 1. E, e.

TCHERNAVIN, V. の記載を読んだ結果、前報記載において不足な点を補足した。

鋤骨部隆起と口蓋骨部隆起との間隔は前者の最大巾の2～3倍であり、鋤骨部隆起の¼—⅓が口蓋骨部隆起の先端より前方へ突出している。

鋤骨部隆起の形態：　隆起先端は鼻孔位置より始り、後端は眼窩の前縁より眼窩径の¼か或は眼窩中央位置まで達している。隆起は低くその巾は眼窩径の⅓—½でめる。歯は弱小で不規則に並んでいる。鋤骨部隆起に続く口腔上壁中軸部には多数の細い皺がある。

口蓋骨部隆起の形態：　隆起先端は鼻孔より後方において始り、後端は眼窩中央位置まで達している。隆起は低く且つ巾狭く、その上に歯が1列に生えている。歯は弱小であり、その大さは不整である。隆起は殆んど直線状で彎曲していない。

口蓋膜は巾狭く、眼窩中央位置までである。

舌は細長く略三角形をなし、比較的平滑である。歯はV字状に並んでいる。

論　　議

本研究に用いたものは全てサケ属（*Oncorhynchus*）に属するので、前報の如く、隆起配置の全貌は何れも小字型をしているが、各種を詳細に比較すれば、その種に応じて口腔上壁の隆起配置に差異があることが認められる。(Fig. 1, Table 2.)。特に、ベニマス、マスノスケでは口蓋骨部隆起に於て、サケ、マスでは鋤骨部隆起の夫々位置関係において、カラフトマスでは鋤骨部隆起の口蓋骨部隆起に対する突出度合において、他種と相違していることが認められた。

サケ科魚類の歯数、歯列及び歯の大さなどが時期により変化することは、DAY (1887)、JORDAN & EVERMANN (1896) らにより指摘されている。TCHERNAVIN (1938) は主として、*Salmo salar, Oncorhynchus gorbuscha* 及び *O. keta* を材料として、成長に伴う変化及び生活環境の変化などにより5つの時期に分け、各時期について頭部にある各骨の形態、歯列及び歯数の変化する状況を示し、頭蓋骨の巾が変化の最も少い点からこれを基準として各骨の相対的長さの変化を記述しているが、口腔上壁における各骨の相互の配置の変化に関しては特に敷衍していない。

鋤骨部と口蓋骨部両隆起の口腔上壁における相互の配置関係について、材料の得やすいニジマス（体長 7.5～17.3 cm）及びカワマス（体長 6.9～24.0 cm）で調べた結果は前回に報告した通り、成長による変化は認められなかつたし、カラフトマス（頭長 12.1 cm ♂, 10.1 cm ♀）及びサケ（頭長 16.0 cm ♂, 10.9 cm ♀）においての雌雄による変化の差異も認められなかつた。今回得られた材料と市販のカラフトマス、サケについては各々 20 尾につき更に検討してみたが、口腔内の隆起配置には何等の差異が認められなかつた。

しかし今回調べた材料はTCHERNVVINによる第2期（沿岸へ洄游してくる時期）及び第3,4期（溯河してから産卵前の時期）に相当するものだけであつたので、生活環境の変化の多い太平洋産サケ科魚類についての口腔内隆起配置の変化の各時期に対する詳細な比較研究は今後続行したい。

摘　　要

1　淡水産サケ科魚類に引続き、太平洋産サケ属のマス、ベニマス、マスノスケ、サケ及びカラフトマスの5種について、鋤骨部及び口蓋骨部両隆起の口腔上壁における相互の配置状態及び

それら隆起や口蓋膜の形態などを分類形質として、比較検討を試みたところ各種別に差異が認められ分類形質として役立つことを知つた。

2 ベニマスとマスノスケでは口蓋骨部隆起に於て、マスとサケでは鋤骨部隆起の夫々位置と形態において、カラフトマスでは鋤骨部隆起の口蓋骨部隆起に対する突出度合が、夫々他種と特に相違していた。

3 調べた材料において、口腔にある分類形質には同一種内における差異は認められなかつた。

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Résumé

Among five species of Pacific salmon ; *Oncorhynchus masou, O. nerka, O. tschawytscha O. keta* and *O. gorbuscha* were compared, i. e., the relative position and the arrangement of vomerine and palatine tooth bands in the roof of the mouth, and the form of these tooth bands, teeth and labial fold as taxonomic characters.

As a result, the above-mentioned characters turned out to be useful for the determination of each species. The main differences between the species are shown in Fig. 1 and Table 2.

O. nerka and *O. tschawytscha* show wide differences in the position and the form of palatine tooth band from other species. *O. masou* and *O. keta* show wide differences in the position and the form of vomerine tooth band. In *O. gorbuscha*, the tip of its vomerine tooth band more projects beyond palatine tooth band than other species, from one-third to one-fourth in length of vomerine tooth band.

Individual variation of these taxonomic characters, in the roof of the mouth, were not found.

Table 2. Summary of

	Oncorhynchus masou	*Oncorhynchus*
Interval between vomerine tooth band and anterior palatine tooth band	nearly equal to the greatest width of vomerine tooth band	1.5–2.5 times the gre vomerine tooth ban
Tip of vomerine tooth band protruding	slightly beyond palatine tooth band	slightly beyond palati
Positon of anterior end of vomerine tooth band	slightly ahead of nostril	slightly ahead of nost
Position of posterior end of vomerine tooth band	as far as one-fourth of orbit diameter from its anterior rim	somewhat beyond ante
Vomerine tooth band in form	low but wide	low and rather narrow
Width of vomerine tooth band	one-third to one-fourth of orbit diameter	one-fifth to one-sixth meter
Middle part of roof of mouth following vomerine tooth band	rather flat	many wrinkles
Position of anterior end of palatine tooth band	nostril or slightly behind it	nostril or slightly behi
Position of posterior end of palatine tooth band	middle of orbit	as far as one-fourth of from its anterior rir
Palatine tooth band in form	high, wide and curved slightly outward in the middle	rather low, narrow a straight
Position of posterior end of labial fold	somewhat beyond middle of orbit	somewhat ahead of m
Tongue in form	rather long, wide and thick	rather long and thin
Arrangement of teeth on tongue	parallel	V-shaped
Teeth in roof of mouth	strong and large	weak and small

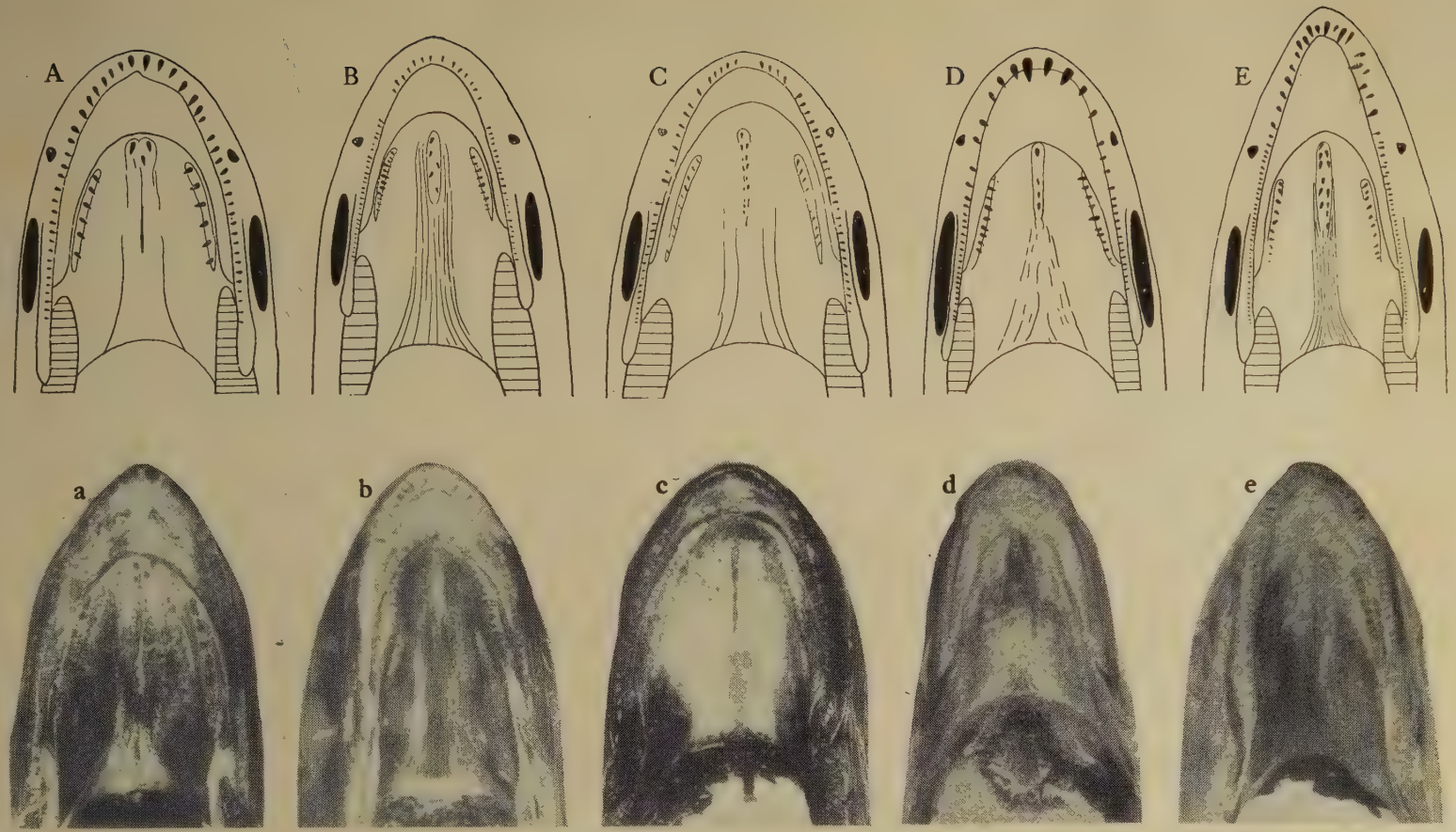

Fig. 1. Roof of mouth of Pacific salmon; above, slightly diagrammatic.
A, a, *Oncorhynchus masou* (X 2/3), C, c, *O. tschawytscha* (X 3/4), E. e,) *O. gorbuscha* (X 3/4)
B, b, *O. nerka* (X 3/4) D. d, *O. keta* (X 2/3),

On the Buoyancy of the Egg of Alaska Pollack, *Theragra chalcogramma*

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The eggs of some kinds of fishes are floating about after the spawning. They are called pelagic eggs. Hitherto little attention has been paid to the nature and mechanism of such phenomenon.

While studying the problems concerning the osmotic regulation of fish egg, Krogh et al ('38) have observed the eggs of plaice floating at first in the water of 25 or 34 ‰ salinity but beginning to sink after a while (1 1/2—3 minutes later). As will be discussed later, there still remain insufficiencies in their explanation for this behaviour. The egg of cod (*Gadus macrocephalus*) which is closely allied to the Alaska pollack, was reported by some authors to be pelagic; while by others to be demersal. However, Tamura ('52) is of opinion that the egg with a diameter larger than 1.35 mm may be floating because the specific gravity of such egg may become smaller than that of the ordinary sea water.

The nature of the egg of Alaska pollack (*Theragra chalcogramma*) has been already recognized as pelagic since Kamiya '24. Recently Yusa ('52) has found, while studying normal development, that the specific gravity of the egg is smaller than that of sea water and still decreases gradually in the course of the development, and thus the fry hatches out in the floating state. On the other hand, for the practical purpose of the propagation of this important market fish in our country, artificial fertilization has been made and the people have often believed that the eggs which have not been fertilized sink in sea water immediately after insemination, while the floating ones are those successfully fertilized. If so, why does the egg float when fertilized? Since there has been no experimental datum nor any exact observation, the matter has been left as an unsolved problem.

In the present study the behaviour and the morphological changes both of unfertilized and fertilized eggs of Alaska pollack in sea water were examined. The specific gravity of the egg was also measured. It will be shown later that when the egg attains to maturity its specific gravity decreases and it floats in sea water whether fertilized or not. Then if the egg remains unfertilized, it begins to sink after a while. Taking into consideration the morphological changes which occur in this case, it is highly probable that the unfertilized egg decreases gradually in regard to its vital activity, losing the osmoregulating capacity against the surrounding sea water. Consequently exosmosis of

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a light substance, namely water, ensues gradually, resulting in the increasing of the specific gravity of the egg, though the egg is activated without insemination (in other words, it is activated parthenogenetically) merely on contact with sea water and behaves for a while as the fertilized egg does.

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II

The study was carried out in winter, during January and February, eggs taken from Alaska pollack (*Theragra chalcogramma*) in the breeding season being employed. The eggs were placed in a small syringe tube (2—5 cc) containing sea water with known specific gravity determined previously by ordinary pycnometer, and then by noting whether they were heavier or lighter than this sea water, their specific gravity was estimated. Sea water was always used after filtration and by adding distilled water diluted sea waters such as 1/2—1/64 were obtained.

Observations were made in most cases with living eggs. However, for the examination of detailed structure fixed materials were also used. Allen-Bouin's fluid was used as the fixative and sections were made by means of paraffin method. They were stained with Delafield haematoxylin and eosin. In addition, Bauer's and Ciaccio's tests for polysaccharide and lipoid were employed in order to ascertain the nature of the droplets existing in the egg.

III

The mature egg of this species is colourless and very transparent, being spherical in form with about 1.4 mm diameter. A funnel-shaped micropyle is found penetrating the chorion at one pole. There are no distinct oil drops, but many small droplets ranging from 5 to 10 microns in diameter are found in the egg cortex (Figs. 1 & 2). These droplets, according to the observation on sections, are embedded in cortical cytoplasm and not stained with Sudan IV by Ciaccio's method, but show positive reaction to the Bauer's test for polysaccharide. Accordingly, they do not consist of lipoid, but contain polysaccharide. It is supposed therefore that they must not be oil droplets but what are called cortical alveoli, because it is obvious that cortical alveoli in fish egg correspond to the 'goutte claire' named by Konopacka ('35) in her cytochemical investigation of oogenesis in fish egg and said to be composed of mucoproteid.

When such mature eggs were put into sea water of 1.0260 specific gravity (temp. 10° C), from the first they were floating on the surface of the water. Thus, the mature

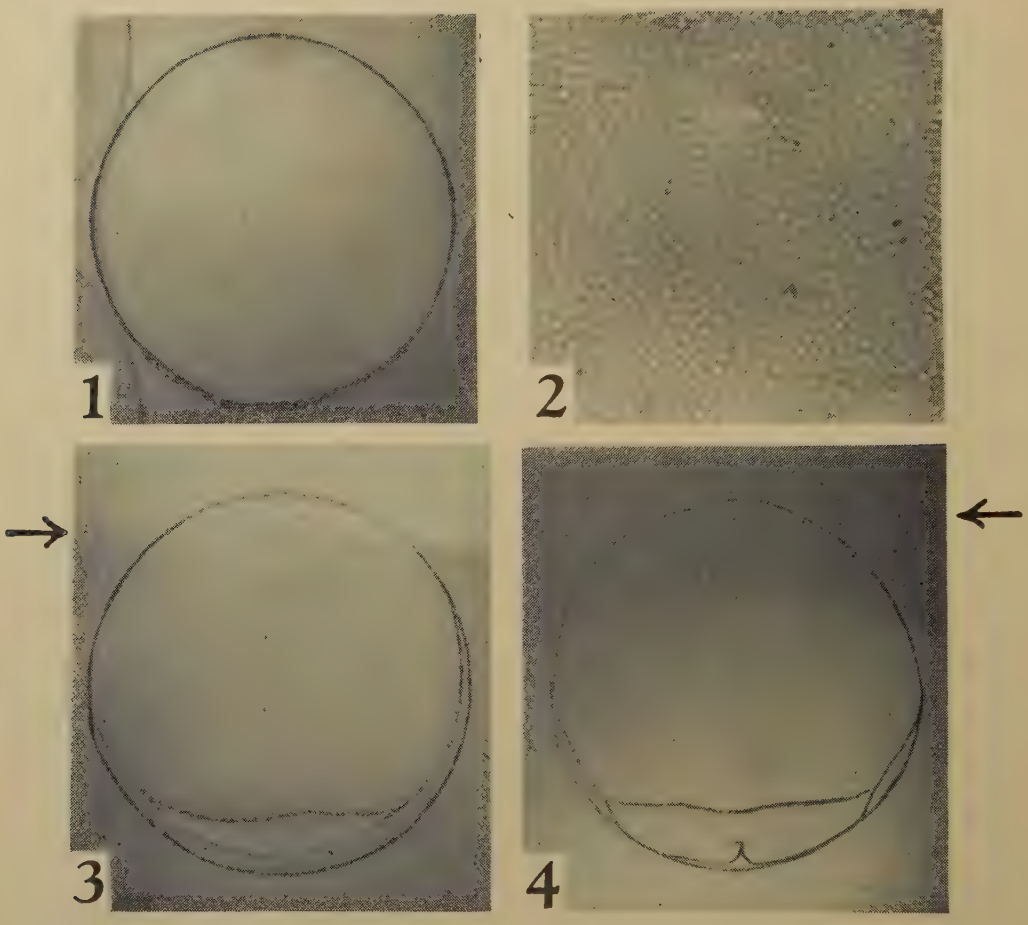

Fig. 1. Intact mature egg. 35 X
Fig. 2. Cortex of unfertilized mature egg. 130 X
Fig. 3. Parthenogenetically activated egg, 90 minutes after immersion in sea water lateral view). Arrow indicates surface of water. 35 X
Fig. 4. 4 cell-stage in floating state in sea water (lateral view). 35 X

egg was found to be lighter than the sea water, that is, its specific gravity was less than 1.0260. In this case its actual specific gravity was estimated as 1.0222. Furthermore, if such eggs were inseminated and fertilized, chorion was thrown off the egg proper progressively, forming the perivitelline space, and then the ooplasm was condensed gradually at one pole to form a raised blastodisc which was continuous at its periphery with the rest cortical plasm. At this stage, the egg was, as a matter of course, floating. The egg proper was biased to the upper pole in the chorion, maintaining the blastodisc in the lower position, and accordingly the perivitelline space was recognized only beneath the egg proper. In this state the development went on passing two-cell, four-cell, eight-cell, morula, blastula stages and so on as in other fish eggs (Fig. 4). Finally fries hatched out also in floating condition. Therefore, it is evident that fertilized eggs are also lighter than the sea water and this state continues till the hatching stage, as Yusa has already pointed out.

Contrary to the foregoing fact it happened occasionally that some eggs sank to the bottom, in spite of their mature appearance, and remained incapable of being fertilized, when inseminated. Observations on the sections prepared from such eggs revealed, however, that there exists a thin unicellular layer outside of the chorion, that is to say, the chorion is covered with a thin layer, the follicle epithelium, which is hardly distinguishable in the living state. This means that they were actually not mature eggs. Consequently, the eggs which sink to the bottom of the sea water and remain unfertilized even after insemination are not eggs incapable of being fertilized in spite of the mature condition, but immature eggs not yet having the capacity of fertilization.

As the actual mature eggs are, whether fertilized or not, lighter than the sea water, they can float. Infertilizable, immature eggs are heavier than the sea water and accordingly sink from the first. Herewith, a question arises how the mature egg behaves in unfertilized condition in the sea water. Then the mature eggs were put into the sea water without insemination and observed. As expected from the results observed already, they were floating at first, but about 2 or 3 hours later some of them began to sink and within about 6 hours all of them had sunk to the bottom (Temp. 9°—11° C). It becomes evident that an unfertilized mature egg is, at first like the fertilized one, lighter than the sea water. However, differing from the fertilized, it becomes heavier with the lapse of time so that it finally sinks if it remains unfertilized. Moreover, morphological changes were observed to occur as follows: When put into the sea water without insemination, the egg (mature egg) exhibits similar morphological changes to those of the fertilized one, in other words, accompanying with the formation of a raised blastodisc, perivitelline space begins to appear. This shows clearly that, merely on contact with the sea water, mature egg is parthenogenetically activated without insemination (Fig. 3). However such activated egg does not undergo cleavage but after a while the raised blastodisc flattens down and disintegrates. Further, it has been found that the sinking of the egg begins with this flattening of the blastodisc. In the sunk egg the perivitelline space is shifted to the upper pole and the egg proper is pushed downwards. The disintegrating appears several hours later. The floating egg has a raised blastodisc but in the sunk one no marked blastodisc exists. Since the flattening of the blastodisc without division is regarded to be in the course of disintegration, the lowering of the vitality in the activated egg may be interpreted as a cause of the sinking of the egg, increasing the specific gravity.

As the causes for the increase of specific gravity, generally speaking, three cases may be considered: viz., (1) penetration of a heavy substance into the egg interior, (2) diffusing out of a light substance from the interior, (3) simultaneous occurrance of (1) and (2). The change of the permeability of the plasma surface of the egg proper*

* Permeability of the chorion is in this case out of the question, for the egg proper rests in contact with the upper surface of the chorion when the egg is floating; on the other hand when it sinks, the egg proper falls downwards to rest on the bottom of the chorion. Furthermore the chorion is in most fish eggs regarded to be freely permeable both to water and salts (Gray '32, T. Yamamoto '36, Aoki '39), which view seems to be substantiated in the present material.

is, therefore, to be considered.

As has been already discussed in the previous paper (Kanoh '52) it is supposed nowadays that in unfertilized fish eggs the surface of the egg proper is not an absolutely impermeable membrane, that is, impermeable to electrolytes while permeable to water though to a small degree. After fertilization, however, the permeability to water may decrease more slowly or may be lost. From this the increasing of specific gravity in question is highly probable due to the diffusing out of a light substance, that is, water in this case, from the egg interior. Since mature egg was found to be osmotically equivalent to M/4.5 NaCl solution as measured by Barger's method, the sea water employed is apparently hypertonic to the egg, accordingly diffusing out of water from its interior may take place gradually when the egg is immersed in the sea water. This would not happen in fertilized eggs, in other words the permeability would not remain simple in this case. The fertilized eggs may become resistant against the hypertonicity of the surrounding medium, floating without increasing specific gravity, that is, the specific gravity of the egg may not be changed after fertilzation even in hypertonic medium, namely the sea water. The same may be proved to occur to some extent in the case of activated eggs. When activated merely on contact with the sea water without insemination, eggs (unfertilized) may be also resistant against the hypertonicity as fertilized ones, and float at least at first without increasing the specific gravity. But when they are in the course of disintegration, they lose gradually the resisting capacity, may be, owing to the lowering of vitality, then they, giving off water from interior, begin to sink with increasing specific gravity. The fact that the raised blastodisc of unfertilized but activated eggs flats down and then the eggs sink may support the explanation.

On the other hand, mature eggs were immersed in hypotonic sea water of various concentrations such as 1/4—1/64 sea water and specific gravity was measured 5 hours later. It was found that the specific gravity decreases gradually in proportion to the hypotonicity of the surrounding medium without marked visible changes, for instance, appearance of a space between chorion and the egg-proper or gathering of ooplasm at one pole did not occur. This may be, contrary to the case of hypertonic medium, due to the endosmosis of water, probable because the diluted sea waters used did not induce egg-activation but were unsuitable media (see the next paragraph), consequently the vitality of the egg might become low from the beginning and so the resistance to the surrounding hypotonicity would not be gained.

Therefore, the increasing of specific gravity of unfertilized mature egg in the sea water may be in the first place* due to the diffusing out of a light substance, namely water, from its interior which ensues on the lowering of its vitality.

IV

* In the second place, penetration of heavy substances, probably salts, may happen, because impermeability to electrolytes may be lost sooner or later as the result of progressive disintegration.

As has been described already, the egg of Alaska pollack is considered to be easily parthenogenetically activated when it comes in contact with the sea water. The same phenomena have also been reported in a brackish water minnow, *Fundulus heteroclitus*, by Kagan ('35) and in a flounder, *Limanda schrenki*, by K. Yamamoto ('51); in the case of *Fundulus*, parthenogenetic activation is induced by immersion in sea water, but not in hypotonic water (fresh and distilled water); also, such activation of the *Limanda*-egg is found to be affected by salt concetration of medium in such way that in concentrated solutions above 1/4 b.s.s. (balanced salt solution, osmotically equivalent to M/4 NaCl) the egg is activated. However in more diluted solutions this is not the case.

Accordingly an attempt was made to discover by what concentration of the medium the egg of Alaska pollack is activated. The results show that the sea water induces the activation in any of the eggs tested and even 1/2 sea water can activate a few of them; more diluted sea water and distilled water can not do so and in non-electrolytic solution such as sucrose, independent of its concentration, egg-activation does not occur. Since 1/2 sea water is, roughly speaking, osmotically equivalent to M/4 NaCl solution which is nearly isotonic to the egg, it is concluded that, as in the egg of *Limanda* or probably of *Fundulus*, parthenogenetic activation of the egg of Alaska pollack is affected by salt concentration of medium and its critical concentration is nearly isotonic to the egg interior.

Thereupon, a question may arise whether the development of the egg is also affected by salt concentration of medium. To examine this point, eggs at the blastula stage were put into sea water of various concentrations (from 1/1 to 1/64). It was found that in an hour after putting into each solution no marked changes occur. However, three hours later in 1/1 sea water the eggs develop to the early gastrulae, whereas in 1/2 sea water the development is suppressed; in 1/4 the once raised blastoderm flats down and the perivitelline space shifts to the upper pole; in 1/8 the perivitelline space almost disappears and nearly all of the eggs are cytolyzed, and in 1/16 to 1/64 sea water all the eggs tested are cytolyzed. Therefore it is clear that the development is also affected by salt concentration of the medium and can not proceed in hypotonic sea water. Thus, the isotonic and also hypotonic sea water are supposed to be unsuitable media for the egg of Alaska pollack.

V

As the mature eggs used in this study had specific gravity of 1.0222 (10° C) which is a much smaller value than that of ordinary sea water, from the date given the following general deductions may be drawn (Fig. 5).

Immature eggs which are incapable of being fertilized are heavier than ordinary sea water and so they can not float but sink in it. On the contrary, when they attain to maturity, their specific gravity become smaller than that of ordinary sea water, and consequently they can float at the surface of water. To the intact eggs ordinary sea water is, needless to say, hypertonic but fertilized or developing eggs gain a resisting

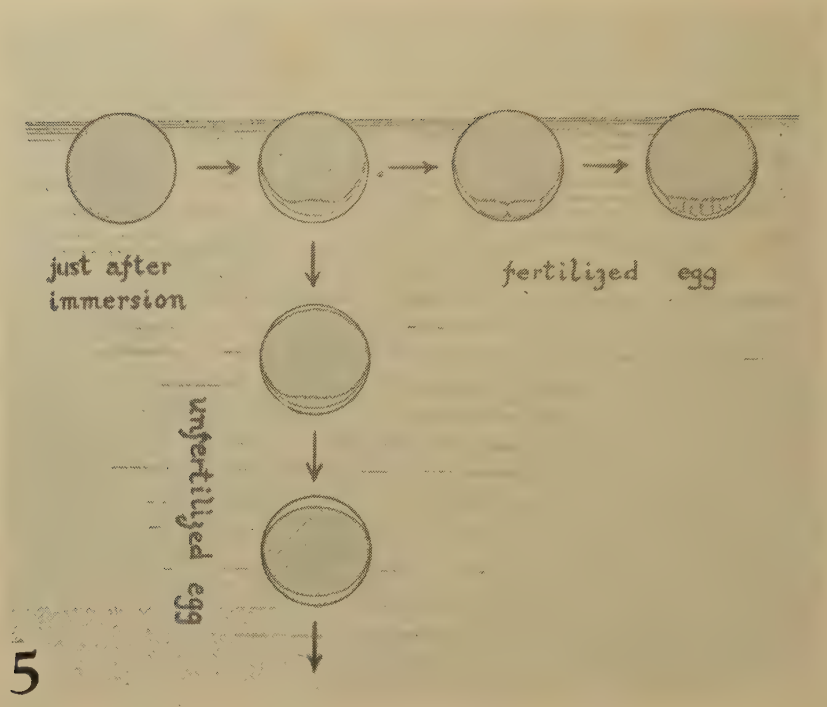

Fig 5. Illustration of behaviour of fertilized and unfertilized egg in sea water. In case of fertilized egg, development proceeds throughout in floating state, on the contrary, unfertilized egg begins to sink after a while with flattening down of the once raised blastodisc, though the egg was once activated to behave as a fertilized egg and was floating for some time at first.

capacity to the surrounding hypertonicity upon fertilization and accordingly they do not lose, as Yusa has reported, floating property at least till the hatching stage.

Thus, the eggs which sink in sea water immediately after discharge must be not yet fully matured eggs, i. e. immature eggs incapable of being fertilized.

Furthermore, unfertilized mature eggs are able to float for some time in sea water since they are parthenogeneitcally activated without insemination when they come in contact with sea water, undergoing the same changes as the fertilized though formed blastodisc does not begin to divide, and they also gain a resistance to hypertonicity of the surrounding sea water. However, with lowering of the vitality they begin afterwards in the course of disintegration to sink as a result of the loss of the resistance to hypertonicity. That is, water diffuses out from the egg interior and the specific gravity increases. Shrinkage of the egg-proper which might happen when water escaped from its interior was not clearly observed in the present study, probably on account of the complicated course of the morphological changes occurring in the process of disintegration.

The fact that the eggs of plaice are floating in water of 25 or 34 ‰ salinity but in such water they become heavier after 1 1/2—3 minutes has been attributed by Krogh et al ('38) to the permeability change of eggs both to water and to salt because the

diameter decreases at first, but increases again returning at least approximately to the initial value. The assumption made by Krogh et al is seemingly similar to that of the present writer. However, it is questionable in what stage of egg——unfertilized or fertilized or parthenogenetically activated eggs —their observations and experiments were performed, as no detailed morphological changes of the egg-proper were described in their paper. In respect to these points further investigation is necessary.

Summary

When the egg of Alaska pollack, *Theragra chalcogramma* attains to actual maturity, it decreases in specific gravity and floats in the sea water, whereas the specific gravity of immature egg is smaller than that of the ordinary sea water. Consequently, it may be admissible to consider that the eggs which sink in sea water immediately after discharge are not yet fully matured, i. e. that they are immatured eggs having no capacity for normal fertilization.

Fertilized or developing eggs float at least till the hatching stage, because, upon fertization, they have gained a resistance against the hypertonicity of the surrounding sea water. The unfertilized mature egg is parthenogenetically activated without insemination when it comes in contact with sea water, undergoing the same changes as the fertilized though formed blastodisc does not begin to be divided, and it gains a resistance against the hypertonicity of the surrounding medium; accordingly it can remein for some time floating in the activated state in sea water. But such an egg begins to sink afterwards from loss of resistance to hypertonicity because of the lowering of its vitality. That is, the diffusing out of water from egg interior occurs and increase of specific gravity of the egg results.

Egg-activation and development are much affected by the salt concentration of the medium and it may be considered that isotonic and also hypotonic sea water are unsuitable media for activation and development of the egg.

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of lower jaw blackish. Teeth are present only on jaws, small, rather slender (being fairly widely separated from one another) and arranged in a few rows anteriorly which taper laterally.

Sclaes are cycloid, large, soft and very deciduous. Lateral line high; there are only ½ 2 rows of sclaes between dorsal base and lateral line. Scales along lateral line *ca.* 50.

Testes attenuated and narrow. Peritoneum not black. Posterior part of pharynx has a pair of hard sacs which are internally provided with papillae bearing teeth. Nostrils paired on each side, located near anterior end of snout.

The general appearance, and more especially that of the head region, is sugestive of *Icticus* and *Tetragonurus*. Color in farmalin is greyish brown, lighter below. The spinous dorsal is much darker than the other fins.

ii) *A young example from Manazuru.* During July-August 5, 1952, Mr. Masaji HIRAI, Manazuru Branch Station, Tokai Regional Fisheries Research Laboratory, collected a young example of *Ariomma lurida* taken by a trap net at Takaura (near Manazuru), and presented it to the writer for study. The specimen measures 113 mm in total length, 103 mm in fork length and 95 mm in standard length. The following measurements are given in hundredths of the standard length: Length of head 20 0, greatest depth of body 26.3, greatest breadth of body 14.7, least depth of caudal peduncle 5.8, diameter of eye* 7.6, interorbital (not bony) breadth (above centers of orbits) 10.5, length of snout 10.5, length of highest (3rd) dorsal spine 12.6, length of highest (2nd) dorsal fin-ray 7.9, length of highest (2nd) anal spine 4.2, length of highest (1st and 2nd) anal fin-ray 6.8, pectoral fin damaged, length of ventral spine 9.5, length of longest (3rd, counted from outside) ventral fin-ray 15.8, length of longest caudal fin-ray *ca.* 20.0.

D. XII 15 (anteriomost 2 or 3 fin-rays unbranched); A. II 15 (anteriormost 1 fin-ray unbranched; P. 23 on each side; V. I 5 (all fin-rays branched; received in a long and narrow groove which reaches anal origin).

Pseudobranchiae very well developed. Inner fold of branchiostegal membrane not covering its partner proximally Branchiostegals 6 on each side. Gill-rakers 9/1/19 (left) and 11/1/19 (right). Shape of tongue as in the larger specimen mentioned above. Tongue and palatines with extremely fine teeth. Jaw teeth are as in the larger specimen.

Scales have been rubbed off. The coloration differs considerably from the adult mentioned above. The tint of the back and inner side of the opercle are as in the adult, but there are three large violet (or dark brown) blotches on the side of the trunk and much smaller markings of irregular shape on the back. Spinous dorsal fin has blackish spots of small size. The ventral fin is mostly black. The caudal, pectoral and anal fins have no markings.

(*continued on p. 255*)

* The adipose eyelid is fairly well developed, but not covering the greater part of the eye.

魚類歯牙の形態学的研究

II. ムツの歯牙に就いて*

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Morphological studies of teeth of fishes

II. Teeth of *Scombrops boops*

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著者は先きに鯛科の歯牙について肉眼的、組織学的観察の報告をなしたが、今回は鱈科の歯牙について報告する。尚、この研究に当り文献の参照その他で御世話下された、東海区水産研究所農林技官阿部宗明博士、東京大学理学部動物学教室江上信雄氏に感謝の意を表す。

I 材料及び検査方法

材料はすべて静岡県伊東魚市場に入荷した *Scombrops boops*（Houttuyn）で全長10乃至20糎のものの上下顎骨、口蓋骨、鋤骨、舌及び咽頭部にみられる歯牙を用いた。

検査方法は前回と同様に行つた。

II 観察所見

1 肉眼的所見

鱈は鯛などと異なり、歯牙を上下顎骨の他に口蓋骨、鋤骨、舌及び咽頭部に有している。

（1）上下顎骨の歯槽部は内外両側の骨板よりなり、歯牙はその間に介在し根部において、これと癒着している。各顎は10乃至15本の歯牙を有し一列に排列している。しかし上顎骨の前方正中部では、更に内方に2乃至3本の歯牙を有しその部は前後二列になつている。

口腔粘膜上皮の高さでわずかに段階を示しているが、形は大体において長円錐形を示している（第1図）。

大いさは長さ2乃至3粍、巾1粍又はそれ以下で、各歯牙は顎の中央附近が最大で前方はこれよりわづかに小さく、特に後方に至るに従いかなり小さくなる。

色は主として白色を呈しているが、エナメル質に被われている部は稍々黄色を呈し光沢を有している。

（2）口蓋骨の歯牙は、上下顎骨の歯牙と同様に口蓋骨の歯槽部の内外両側骨板間に介在又は一側に偏在し、根部では両骨板又は一側の骨板と癒着している。その数は各々数十本で大体二列時に三列に排列している。

形は上下顎骨の夫れと同様長円錐形をなし、前者より全体的に小型で、大いさも長さ1粍、巾0.3粍前後で前方のものは後方のものに比してわづかに大きい。

色は上下顎骨のものより稍々黄色乃至褐色度が強い様である。エナメル質の被覆部と他の部との色調の差は区別されない。

（3）鋤骨、舌及び咽頭部の歯牙は前二者より更に小さく絨毛状歯牙で群在しており、固有の

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色調は記し難い。

以上これらの歯牙は、いづれも内後方に彎曲している。

2 組織学的所見

鮭の歯牙は、エナメル質と象牙質とからなり、セメント質を欠く。象牙質は Osteodentin の像を示し顎骨に癒着している。

（1）エナメル質

エナメル質は歯牙の口腔内に突出している部分、即ちその尖端より⅓乃至½をCap 状に被い、（第1図）、脱灰操作により完全に消失する。その構造は全く無構造で、極めて薄く各部は均等な厚さを示している。

しかし鋤骨及び舌、咽頭部のものはエナメル質が存在すると決定するには歯牙があまりにも小さく明確にし得なかつた。

（2）象　牙　質

象牙質は口腔内ではエナメル質に被われているが、これ以下は周囲軟組織により被覆せられている。根部は支持骨及び隣在歯牙の根部と移行している。

象牙質は人類に於けるものと異なり、その中に象牙細管を有せず、その構造は全く別な型のものである。此れは Owen の云う Vascular, 又は Vasodentin, 更に Tomes が Osteodentin といつたものの像に一致している。即ちこの象牙質は Owen の云う Medullary canal を含み、Medullary canal の中には造象牙細胞、血管及び結合織細胞即ち歯髄細胞を容れている。

a, 象牙質基質

象牙質基質はその外形が早期に形成され（第2図）、次いでその中心部が形成される（第3図）。そして完成後の歯牙に於いては殆んど無構造に見られるが、完成直後のもの及び形成期のものはその中に歯牙の長軸に並行に走る結合織線維が認められ、就中形成中のものにおいてはその線維は末端で細く岐かれ周囲結合織中に入つたり、線維細胞に連結したりして終つている（第4図）。歯牙の横断標本においてはこれら線維は Medullary canal を囲こんで走つている（第5図）。

象牙質基質と Medullary canal との境界部には石灰化の低い一層、即ち幼若象牙質層が存在する。これは歯牙の形成完了と共に消失する。

b, Medullary canal

象牙質基質の中を不規則であるが上下に走り、更に隣在のものと処々で交通している骨髄様のもので、Owen のいう如くこれは歯髄と見做されるものである。Medullary canal はその外表に造象牙細胞を、その内部には多くの血球を容れた血管、歯髄細胞を含んでいる。しかし象牙質基質の石灰化するに従つて細胞成分は減少し、血管とわずかの歯髄細胞を残すに至る（第6,7図）。

c, 造象牙細胞

象牙質基質の内面に一列に排列する多角形乃至股子形の細胞であつて、原形質は比較的多く、円形の核一個を有し、隣在のものと突起により連結している。

造象牙細胞は結合織細胞より由来し、象牙質の形成期に出現し、象牙質の完成、脱落期に至り次第に減少し終には消失する（第7図）。

造象牙細胞は歯牙附近にみられる骨の周辺に存在する造骨細胞と形態的に類似し識別困難なものがある。

d, 血　　管

Medullary canal の主成分で紡垂形の内皮細胞を有する管腔をなし、その中に有核赤血球を入れている。

e, 歯 髄 細 胞

歯髄細胞は周囲結合織細胞と同一形態を示し Medullary canal の中に存在することにより他から区別せられる。この細胞は紡垂形又は三角形をなし比較的原形質に富める--個の核を有するもので、原形質突起により同種の細胞と網を形成している。その量は歯牙の形成期には少くその存在が不明瞭であるが、脱落期に至り次第にその数を増す。

（3）エナメル・象牙境

エナメル質と象牙質との境界は特別な形態を示さず、単に象牙質の頂部をエナメル質が被覆する様に形成されたと考える程度のものである。

（4）骨 ・ 象 牙 境

象牙質はその根部において骨に接するや急に Medullary canal の量を減じ骨に移行している。又、骨は象牙質に比して比較的ヘマトキシリンを多くとる。此れは両者の識別の一助にはなるが決定的なものではない。

骨中に認められる管腔と象牙質中の特に末期の Medullary canal とは区別がむつかしく、本質的には同一のものと考えられる（第8, 9及び10図）。

尚各歯牙は互にその根部で移行しており、明らかな境界はなく Medullary canal の走行状態による区別も局部的になされるに過ぎない程度である。

（5）そ　の　他

完成せる各歯牙の間の結合織中には、単に口腔上皮が肥厚したものから、根棒状の上皮索となつて内方に陥入したもの、エナメル器を認める各形成期の歯牙、更に殆んど完成しエナメル器の残遺を周囲に残こすものに至る迄、代償歯牙の各発育過程のものがみられる（第11, 12図）。

歯牙の脱落は根部より起るものではなくして、歯牙の長径の中央附近より折れ去る様にして生ずるのである。そして残りの部分はエナメル器の形成、歯牙の萠出に際しての吸収及び骨による置換等により処理される。

Ⅲ 考　　按

鮭の象牙質は Owen のいう Vascular dentin 又は Vasodentin の像を示している一方、Tomes のいう Osteodentin の像でもある。Owen はその Medullary canal の内容に血管系の豊富な存在により Vaso とか Vasucular という語を用いた。又、Tomes は彼のカマスの歯牙の研究により Osteodentin を決定し、後に鱈の歯牙で Vasodentin と明確に区別している。更に後年 Von Korff は “Osteodentin は Dentin でなく髄腔が発育している真性骨組織である” といつている。著者は鮭の歯牙の観察にあたり、その Medullary cannal と骨髄腔の内容物の検査を行つた結果、Tomes のいう Vasodentin とは全く異なり、多くの骨髄腔は歯牙の脱落期の Medullary canal の状態に一致しており、唯血管の存在が稍々不明であつた。しかし一部においては歯牙の形成期の Medullary canal の状態に類似しており、更に血管の存在も認められた。又、骨及び象牙質の形成細胞はその区別がむつかしく、一部では全く区別ができない。更に骨には象牙質にみられたと同様幼若象牙質に一致する石灰化の低い層が形成細胞に接してみられる（第10, 13図）。

以上の如き所見は、Owen の如く Vascular 又は Vasodentin と称えるよりむしろ Korff の考えの如く骨と見做すべきものであり、一方その形成過程からして歯牙というべきものでもあ

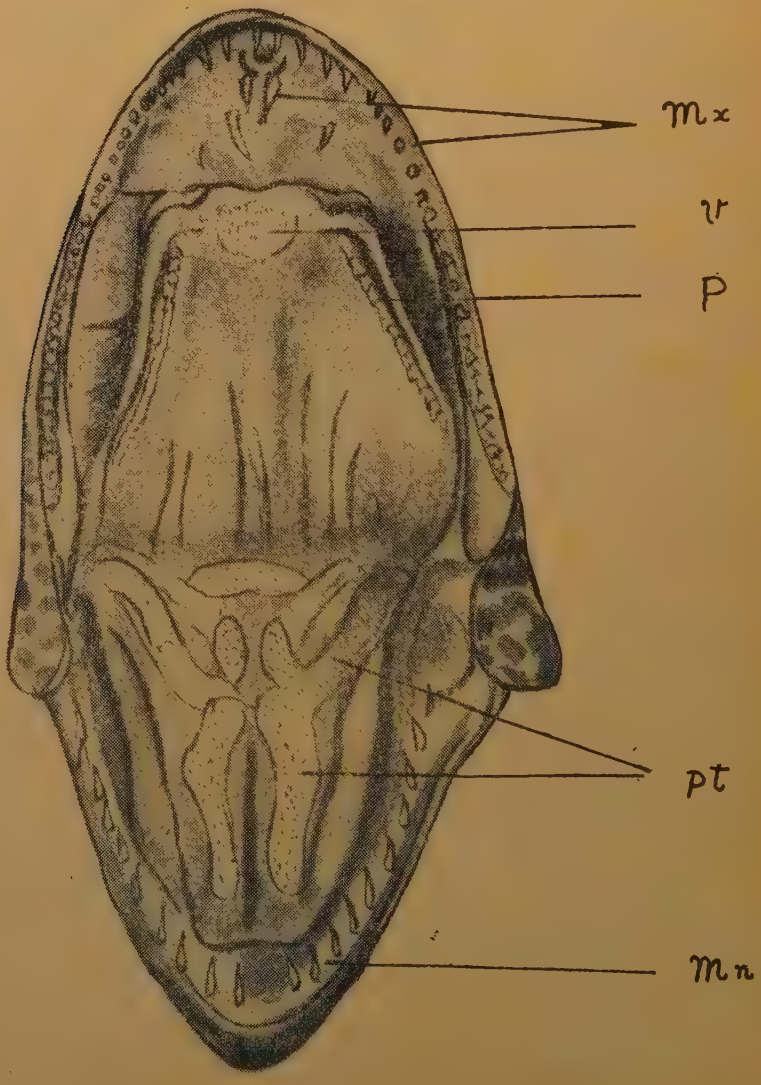
る。従つて著者は此れを Osteodentin と称えて良いものと考える。この考えは第1報における鯛の Osteodentin とも何等矛盾を示さない。

舌及び咽頭部、鋤骨の歯牙はその肉眼的所見は不充分であるが、組織学的所見から前述の如きものと思惟するものである。

Ⅳ 総　　括

1 鮭は上下顎骨、口蓋骨、鋤骨、舌及び咽頭部に歯牙を有しいずれも同型歯で後者になるに従いその大いさは小となり、いずれも内後方に彎曲している。

2 歯牙はエナメル質と象牙質よりなり、エナメル質は脱灰操作により全く消失する殆ど無構造の組織である。象牙質は Osteodentin の像を示し、根部は骨及び隣在歯牙の根部に移行している。



Front view of the opened mouth. Mx, maxillary teeth. V, vomerine teeth. P, palatine teeth, Pt, pharyngeal, and lingual teeth. Mn, mandibular teeth.

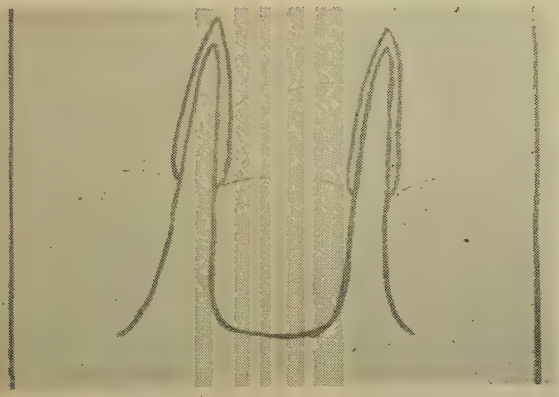


Fig. 1. Shows the relation of enamel and dentin.

Fig. 2. Tooth germ with initial dentin development.

Fig. 3. Tooth germ with half formed dentin.

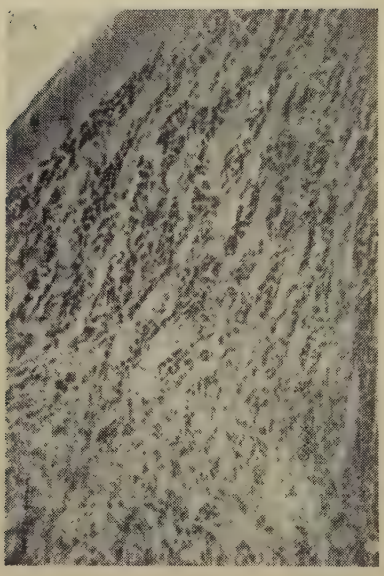


Fig. 4. The ends of dentinal fibrils.

Fig. 5. Before the formation of dentin, situation of the fibrils (trans. section).

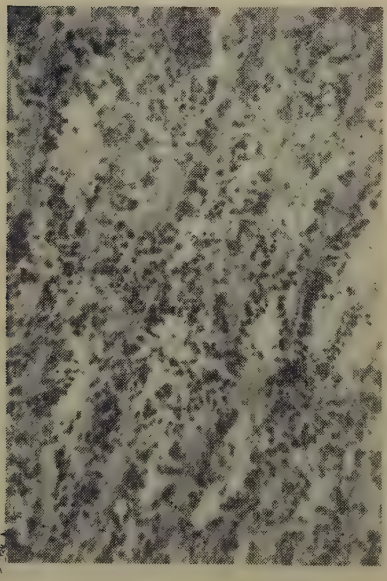


Fig. 6. Views of medullary canals, are apparent odontoblasts and blood vessels.

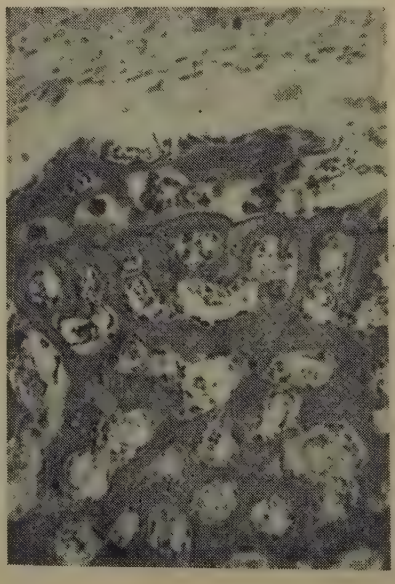


Fig. 7. Trans. section of medullary canal.

Fig. 8. The junction of bone and dentin.

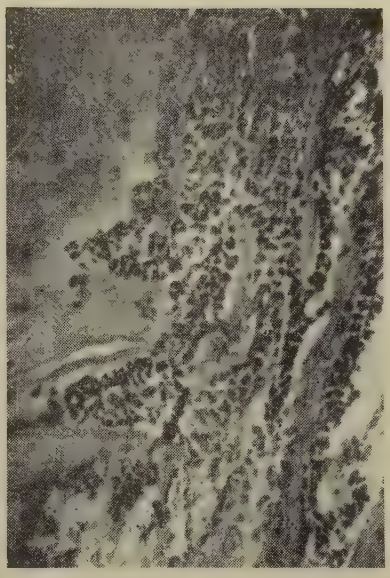


Fig. 9. Higher magnification of the fig. 8. the odontoblasts and the osteoblasts are discriminated.

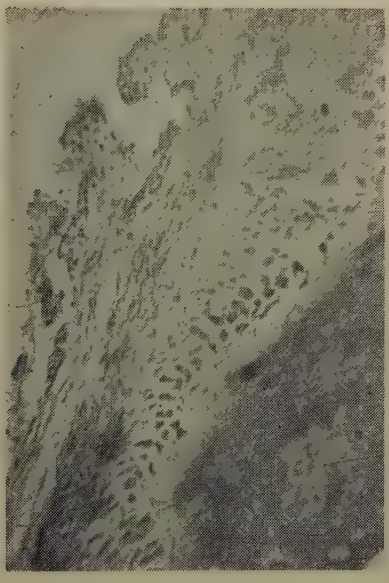


Fig. 10. Osteoblasts which are arround of bone.

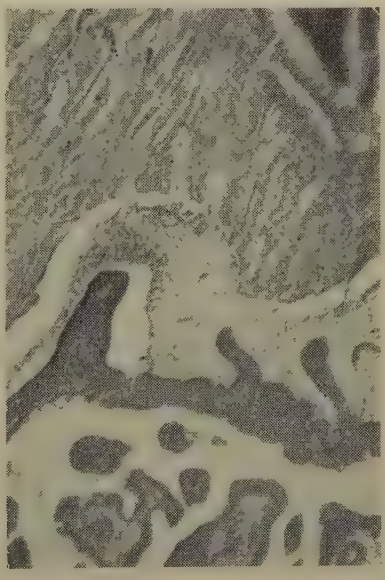


Fig. 11. Club-form development of epithelium.

Fig. 12. Stadium of enamel organ formation.

Fig. 13. A layer of younger bone in the arround of jaw.

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Résumé

1. Material and Method

The materals used are the teeth of the upper and lower jaws, palatine, vomer, tongue and pharynx of *Scombrops boops* (HOUTTUYN), measuring 10-20 cm in total length. The same method as before has been adopted.

2. External features.

The alveolar parts of the jaws and palatines consist of inner and outer bony

plates. The teeth are either inserted between these plates or attached to either of the two. The teeth of the jaws stand in a row, and the palatine teeth are in two rows. These teeth are all elongated cones. The vomerine, lingual and pharyngeal teeth are very small and swarm in the form of villiform teeth. They curve inwards and backwards.

3. Microscopic Findings.

With the exception of the villiform teeth of which the presence of enamel is doubtful, all the teeth consist of enamal and dentin.

The enamel is of homogenous structure, and covers one half or one-third from the apex of a tooth.

The dentin of this fish is identical with the osteodentin described by C. S. TOMES in his study of the pike, and includes what R. OWEN called medullary canal.

These teeth when fully developed, are anchylosed to the bones.

(continued from p. 246)

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In addition to the publications* referred to by KATAYAMA (1952), the following have been consulted:

JORDAN, D. S. 1923. A classification of fishes including families and genera so far as known. Stanford Univ. Univ. Publ. Ser., Biol. Sci., iii, no. 2, pp. 77–243, i–x.

KATAYAMA, M. 1952. A record of *Ariomma lurida* JORDAN *et* SNYDER from Japan, with notes on its systematic position. Jap. Journ. Ichth., ii, no. 1, pp. 31–34.

D. A record of an adult female of Icticus pellucidus from Kushiro. It may be an apology for the brief reports by the writer on rare fishes that additional specimens of these fishes have come to light one after another along with other valuable specimens of fishes. Recently Mr. M. SAKURAI (Chief, Kushiro Branch Station, Hokkaido Regional Fisheries Research Laboratory, Kushiro, Hokkaido) has kindly sent the writer an adult female of *Icticus pellucidus* (LÜTKEN) taken on July 8, 1954, in a salmon drift-net set 30 miles south of Kushiro. It is a giant, measuring *ca.* 480 mm in total length, 426 mm in fork length and 400 mm in standard length. The left ovary is 60 mm in length, 10 mm in breadth; the eggs are hardly visible to the naked eye. The following measurements are given in hundredths of the standard length: Length of head 30.0, greatest depth of body (at anal origin) 29,3 greatest breadth of body (at posterior end of head) 11.9, breadth of body at anal origin 9.5, least depth of caudal peduncle 7.0, diameter of eye** 7.5, interorbital breadth (not bony) above centers of orbits 9.0, length of snout 9.9, length of highest (5th) dorsal spine 7.0, length of highest (3rd) soft fin-ray of dorsal 8.4, length of highest (3rd) soft fin-ray of anal 7.5, length of longest (5th and 6th) fin-ray of pectoral 15.0, length of longest (3rd from outside) fin-ray of ventral 6.8.

D. XII 30 (=ii+28). The 1st through 11th spines fitted in a distinct, but narrow groove; 12th spine nearer to 1st soft fin-ray than to 11th spine. A. II29 (=i+28). P. 19 on both sides. The uppermost 2 fin-rays unbranched. V. 6 (=i+5) on both sides. The innermost fin-ray is connected by a membrane with the inside of the groove which extends from the ventral origin to the vent and receives the ventral fins.

---

* The paper by GILCHRIST and von BONDE 1922 (1924) has not been seen by the present writer.

** The eyeball is well separated from the margin of the orbit.

Pseudobranchiae very well developed. Branchiostegals 6 on each side; left or right branchiostegal membrane proximally not covering its partner. Gill-rakers 9/1/15 i (left) and 9/1/15 (right). Pored scales in lateral line *ca.* 110; opercular bones covered with scales of moderate size; upper part of head naked; scales cycloid and deciduous.

Teeth of upper and lower jaws very small and arranged in a single raw; those of upper jaw extremely fine, tips being widely apart from one another. Number of teeth of upper jaw *ca.* 30 (left) and *ca.* 29 (right). They are proximally covered by a thick continuous membrane. Teeth of lower jaw triangular, mostly directed backwards, and provided on each margin with a few antrorse spines which are invisible to the naked eye. Number of teeth of lower jaw *ca.* 53 (left) and *ca.* 55 (right). They are fairly close-set and covered proximally by a continuous membrane. Palatine has a few small teeth, but vomer is edentulous. Despite higher number of jaw teeth, rounded lower jaw and lower body, the present specimen well agrees with the younger examples reported upon by the writer under the names of *Papyrichthys ischanus* and *Icticus ischanus* (Japan. Journ. Ichth., vol. iii, no. 2, pp. 92, 93, fig. 2; vol. iii, nos. 3/4/5, p. 170) in many other characters. It is especially interesting to note that the palatine has a few teeth in the present specimen as in the specimen from Okinawa described by JORDAN and THOMPSON (1914), and that the vomerine teeth are lacking in the former specimen whereas in the latter specimen they are present. The coloration of the present specimen is generally darker than in the younger ones. The buccal cavity, lining of gill-chamber and the ventral side of the body are black (although the first is covered with the mucus which is grey in formalin).

For "References" see TOMIYAMA and ABE's "Figures and descriptions of the fishes of Japan", vol. L. Under press.

(to be continued)

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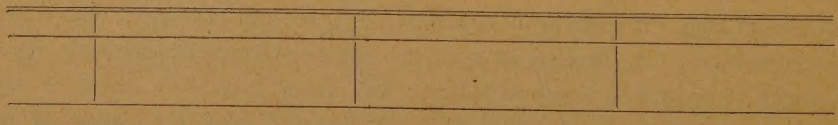

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